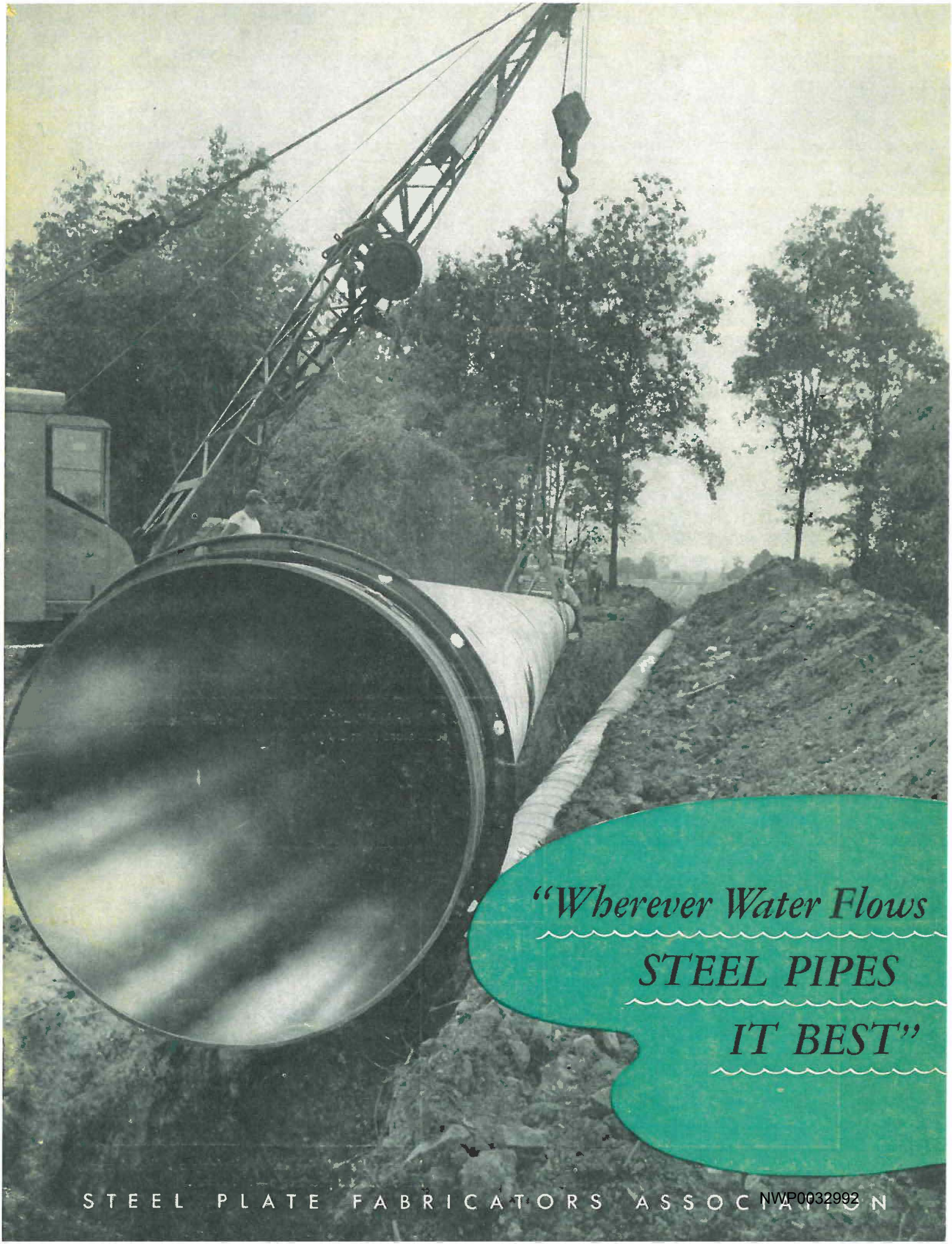
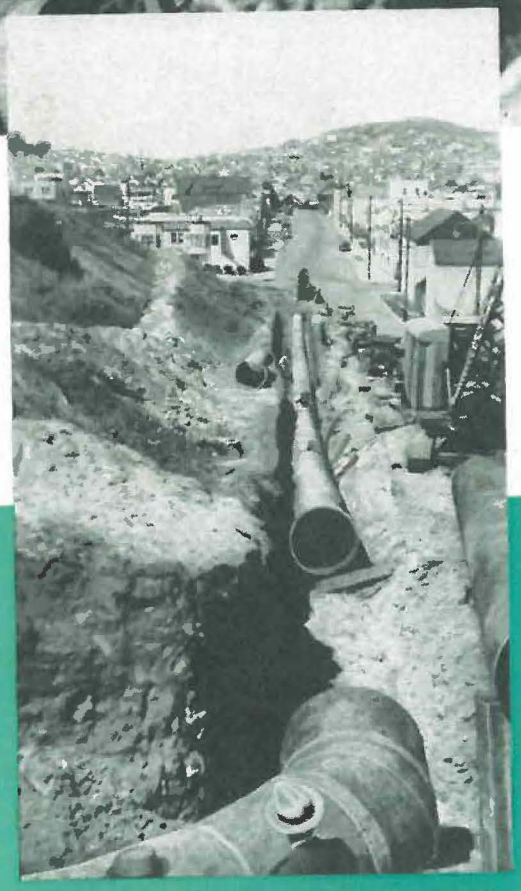
EXHIBIT S-24-1.7



STEEL PLATE FABRICATORS ASSOCIATION

"Pike's Peak or bust"—Hauling steel pipe for a water line up the famous peak more than 30 years ago.



A 44 inch—3/16 inch thick steel water line laid 72 years ago in San Francisco, in service today.

Wrapped steel pipe installed along a railroad trestle more than 50 years ago—still in use.

HISTORY OF STEEL PIPE

SEARCH FOR DURABILITY

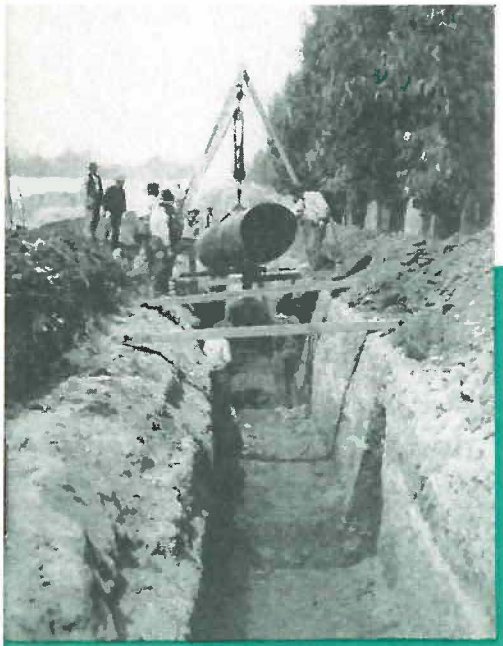
Thousands of years ago men first learned the secret of conducting water through crude pipes. Long before the birth of Christ, the Chinese transported water through bamboo; a Babylonian king who reigned 4500 years ago had a bathroom with tile drain pipes; a municipal reservoir served Carthage about 800 B.C. and there is much evidence of the fine water supply systems of the Romans.

But as cities grew larger, and homes were built closer to each other, the problem of adequate water supply became acute and intensified efforts to construct more durable piping systems. This was especially so in the early days of this country when every means of enticing settlers was used to build up the new cities. Iron, used in Europe for pipe as early as 1685, was scarce in the United States and much more valuable as material for muskets. So our first pipe lines—in such cities as New York, Boston and Philadelphia—were constructed of bored logs as early as 1752.

American ingenuity was even then working hard to solve the problem of a pipe with real durability, and by 1825 a method of manufacturing pipe from long strips of hot metal was devised. This might be said to be the first basis for making strong pipe economically. Pipe mills, making wrought iron pipe, sprang up in several cities, and with the development of the Bessemer process in 1855 and the open hearth process in 1861, steel, the strongest and most versatile refinement of iron, became available for water pipe. The long years of steady development to combine the vitally necessary durability with strength had finally ended, and steel pipe was ready to play the truly dramatic role it has filled in the development of the country.

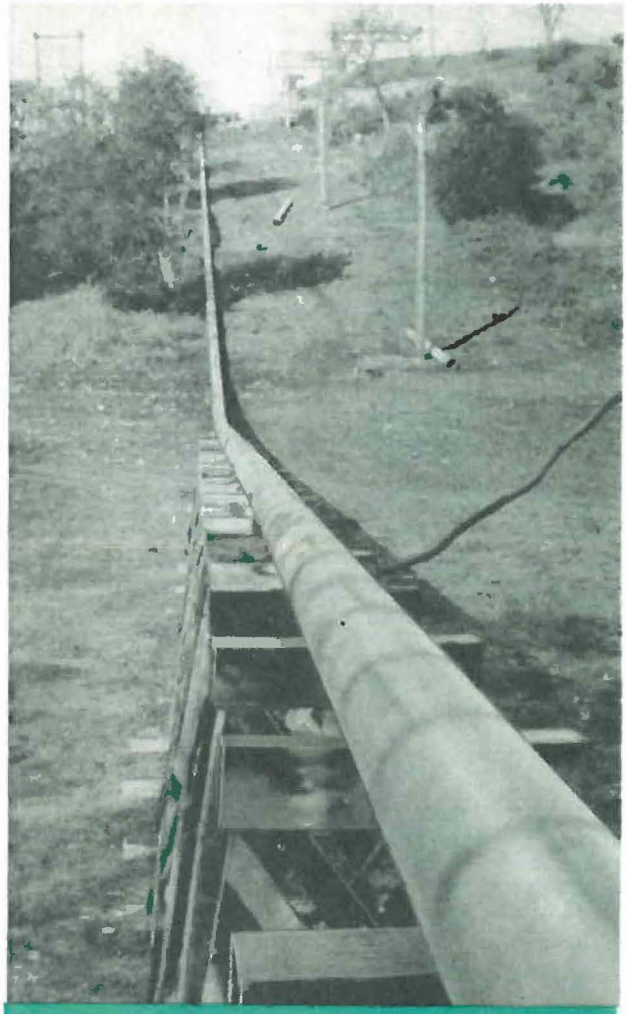
LONG SERVICE RECORDS

Available records disclose installations of steel pipe still in use which were laid as early as 1863—92 years ago—in a five mile line for supplying water to San Francisco. Beginning in 1870 with other riveted lines, and in 1887 with the installation of the first welded steel pipe, records show scores of examples of steel pipe, still in use and giving excellent service, which was laid more than 50 years ago. These records of long service are especially significant of the basic durability of steel when it is remembered that a majority of the pipe was laid before the advent of modern protective lining coatings, and wrappings. Of particular interest is the considerable improvement in



A steel water pipe line being installed in the far west in 1885. After 70 years, this line is still in service.

Preparing to install 84 inch coal tar enameled steel pipe for the city of Baltimore in 1915. This line is still in service.



In 1858 steel sheets, shipped to San Francisco for building needs, were rolled into pipe 11 inches to 22 inches in diameter and installed in Calaveras County, Calif. The pipe has been in use practically continuously since that time. Service life to date—97 years.

the quality of steel which has taken place in the past twenty-five years. Modern steel water pipe mains, properly lined, coated, wrapped and coupled, can be conservatively estimated, therefore, to have a useful life of at least 100 years.

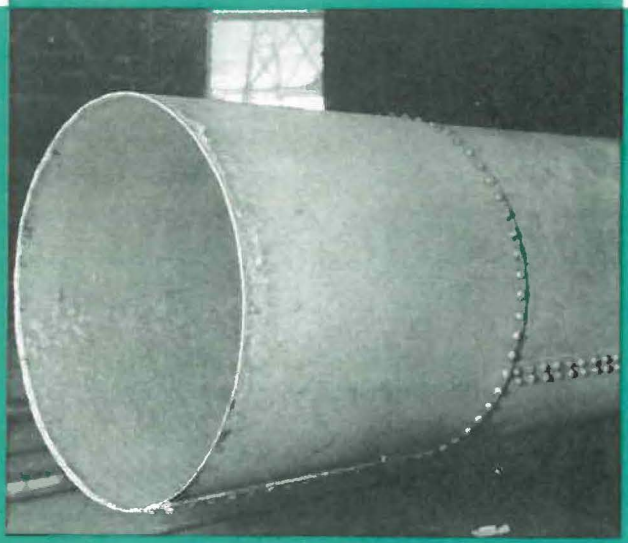
USE TODAY

More than 200 of the major cities of the United States now have a total of more than 100 million feet* of steel water pipe in use. This figure could be greatly increased by the inclusion of pipe in use by hundreds of smaller municipalities, as well as the various district, state and national public projects which call for the use of water carrying pipe. Foreign cities and governments, too, have been users of steel pipe for many years.

LONG TIME USERS

The following list of installations illustrates the longevity of serviceable use as a major characteristic of steel water pipe:

*Bureau of Commerce
American City Magazine



Steel water pipe, originally installed at Portland, Oregon, in 1895, taken out of service in 1953. After reconditioning by cleaning and coating the pipe was in almost 100 percent original condition and relaying was authorized by the Corps of Engineers, U. S. Army.

City of San Francisco—44" riveted steel water line as installed in 1885. The line is still in service.

PARTIAL LIST OF EXISTING

STEEL PIPE INSTALLATIONS

WITH 50 OR MORE YEARS OF SERVICE

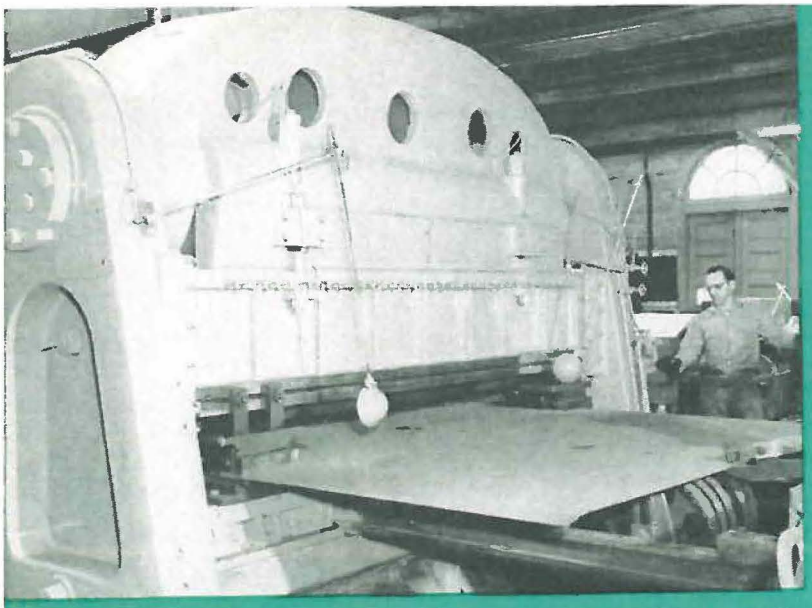
LOCATION	INSTALLED	SIZE	YEARS OF SERVICE
New York, N.Y.	1860	120″	95
San Francisco, Calif.	1863	30″	92
Magalia, Calif.	1870	30″	85
Pittsburgh, Pa.	1874	50″	81
Carson City, Nevada	1874	12″	81
Los Angeles, Calif.	1880	44″	75
Lawrence, Mass.	1881	77″	74
Pasadena, Calif.	1888-89	22″	67
Detroit, Mich.	1890	62″	65
Newark, N. J.	1891	36″ & 48″	64
Rochester, N. Y.	1893	36″	62
Syracuse, N. Y.	1893	54″	62
Portland, Oregon	1894	42″ & 33″	61
Vancouver, B.C.	1895	22″ & 16″	60
New Westminster, B.C.	1896	14″	59
New York, N. Y.	1896	72″	59
New Bedford, Mass.	1896	48″	59
Minneapolis, Minn.	1897	50″	58
Jersey City, N. J.	1897	48″	58
Ogden, Utah	1897	72″	58
Paterson, N. J.	1897	42″	58
Duluth, Minn.	1898	42″	57
Albany, N. Y.	1898	48″	57
Seattle, Wash.	1899	42″	56
Kansas City, Mo.	1903	36″	52

"Wherever Water Flows

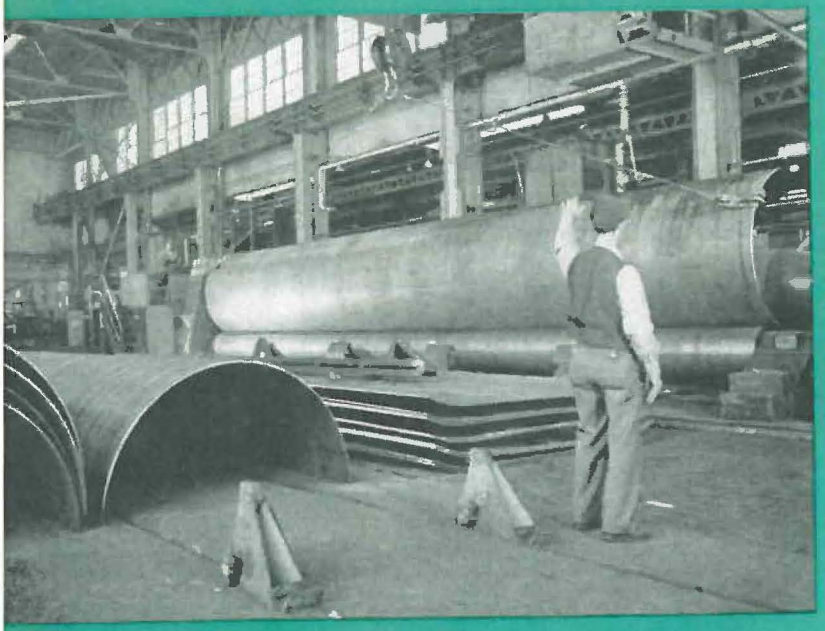
STEEL PIPES

IT BEST"

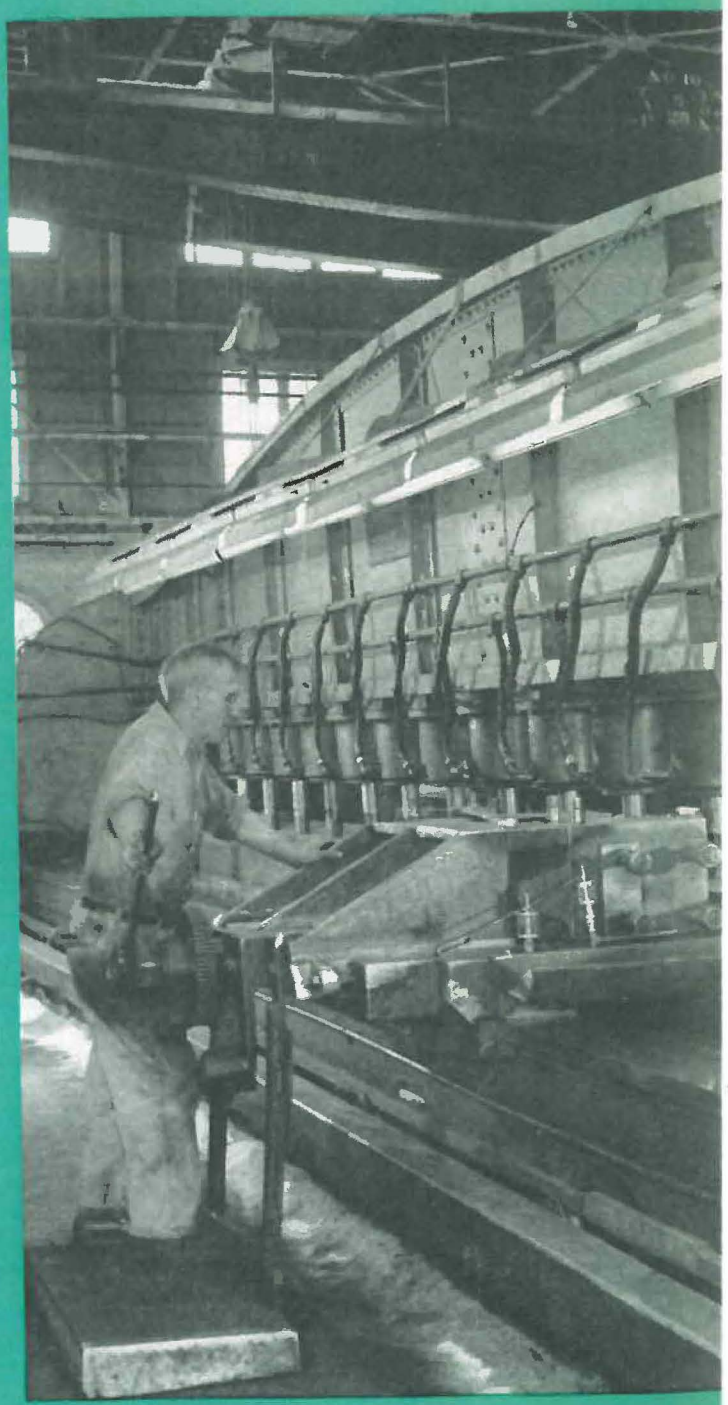
NWP0032996



Crimping the edges of a steel plate preparatory to rolling into cylinders.

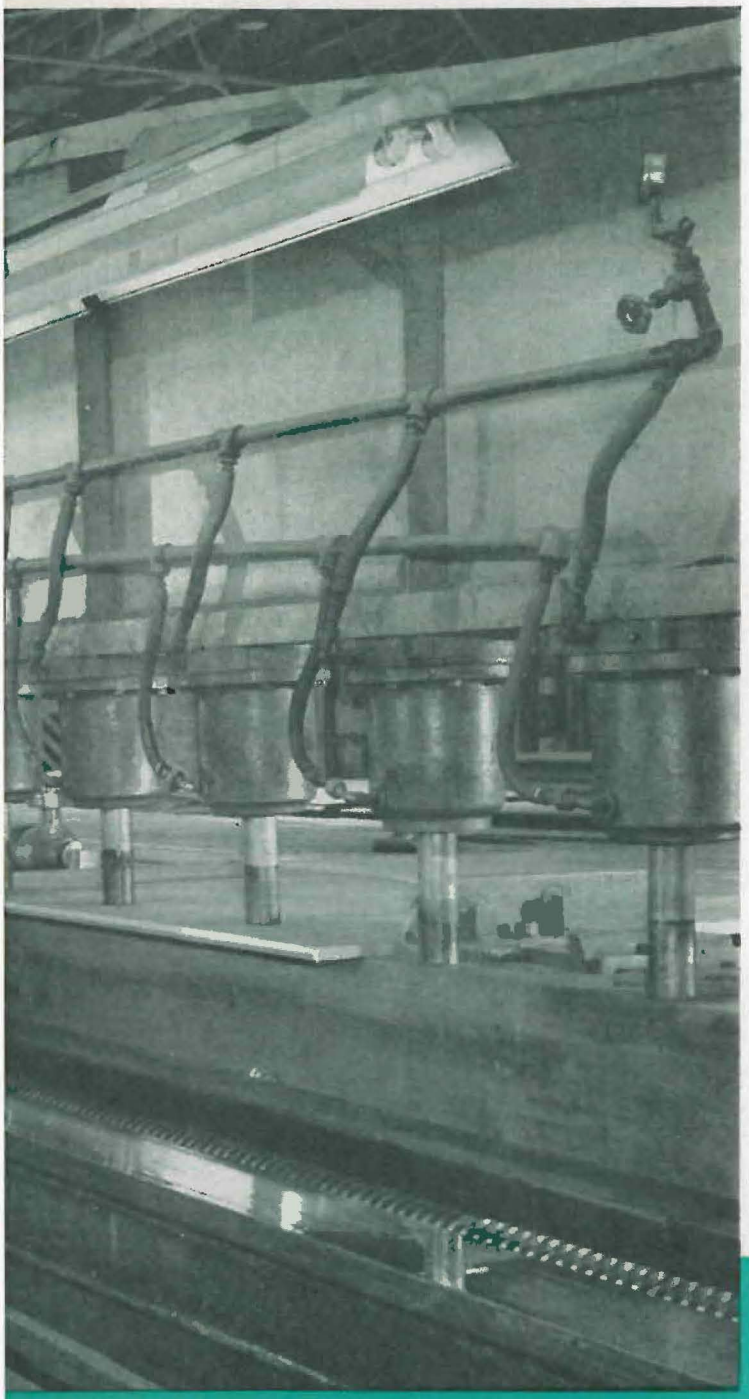


Forming of half cylinders on 40 foot roll. Note crimped plates in foreground ready for rolling, as well as completed half cylinders.



Forming a 32 foot steel plate into a cylinder in a new automatic plate roll machine.

HOW STEEL PIPE IS MANUFACTURED



Automatic beveling machine preparing edges of steel plate for electric arc welding.

As we have seen, steel pipe, when properly designed and installed, has an extremely long useful life. Since it has in addition so many advantages over other carriers of water, there must be definite reasons for its superior characteristics. A review of some of the basic facts about the manufacture of steel into pipe points out some of these reasons:

SPECIFIC MANUFACTURING PROCESSES

There are several methods of manufacture of large dimension steel pipe for use in water conveyance. Each permits fabrication in specific diameters. Available lengths vary from 30 to 50 feet. Wall thicknesses can be furnished to meet any operating conditions. But all of them have one attribute in common . . . the great strength of the finished pipe.

1. *Fusion Welded* (electric-arc welded)

Longitudinal Weld: This type of pipe is manufactured by preparing or trimming the edges of steel plates to size, forming the plates into cylindrical shapes, and welding them together by the automatic submerged-arc process. Thus, a welded joint strength equal to that of the plate itself is obtained. This pipe can be shop fabricated in sizes limited only by the carrying capacity of a common carrier. Sizes up to 12 feet in diameter come within this category. Larger sizes can be erected in the field, after shipment in knocked down form from the fabricating shop.

Spiral Weld: Long strips of flat rolled steel are trimmed and straightened. Then an automatic machine prepares the edges for welding and spirally winds the steel into a continuous tube of the required diameter. An automatic submerged-melt type electric

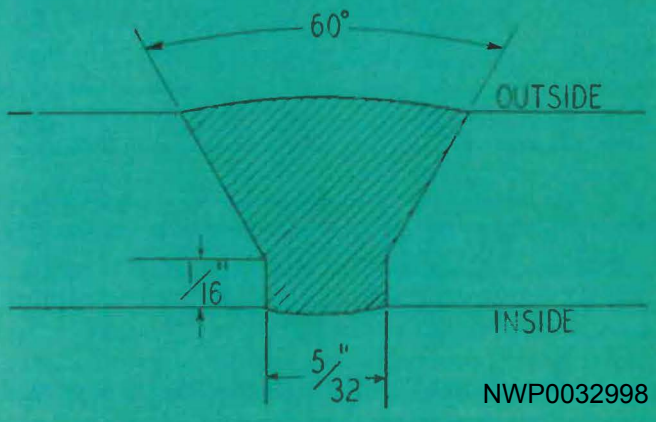
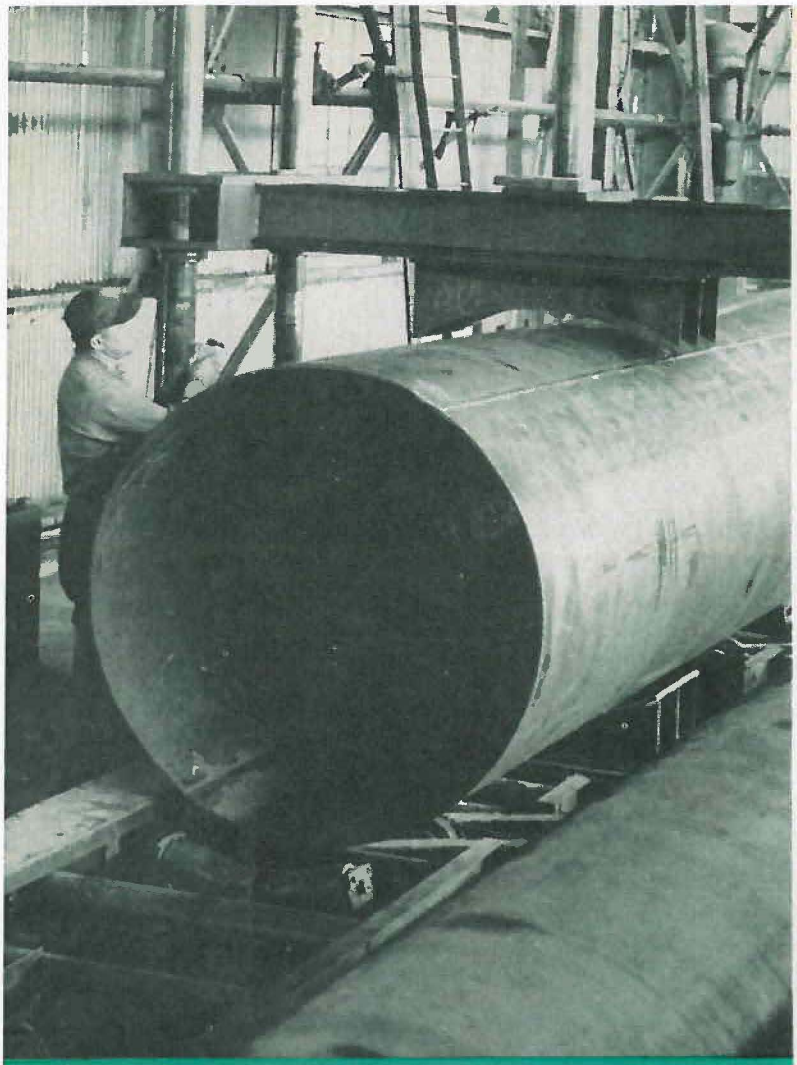


Diagram of typical weld for field girth seams 60 degree single V with 5/32" root opening.



Close up view of press for insuring perfect roundness of pipe ends.

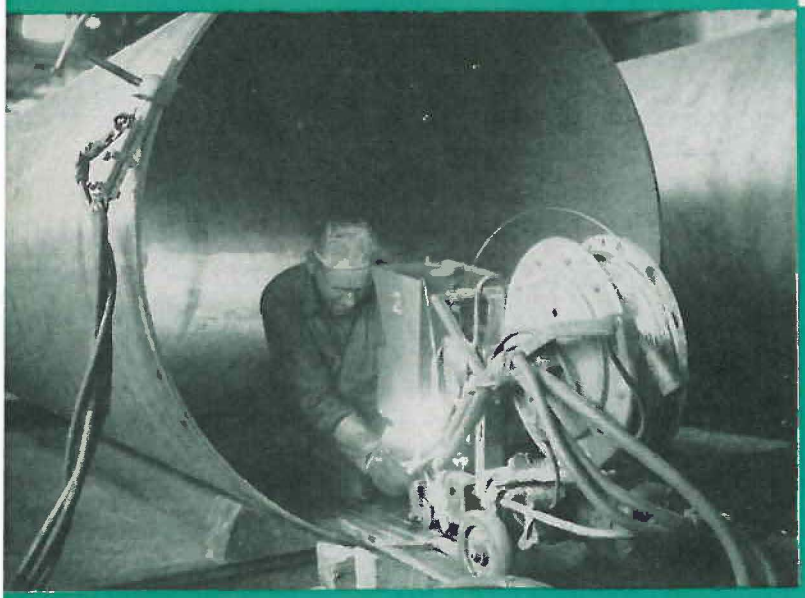
arc butt-welds the seam as it leaves the forming machine. Sizes range from 4 inches to 36 inches in diameter.

2. *Resistance Welded:* Long sheets in coils are formed into cylindrical shape and fused together progressively by means of pressure and heat generated by high amperage electric current. This pipe is made in sizes of ⅛ inch to 16 inches in diameter.

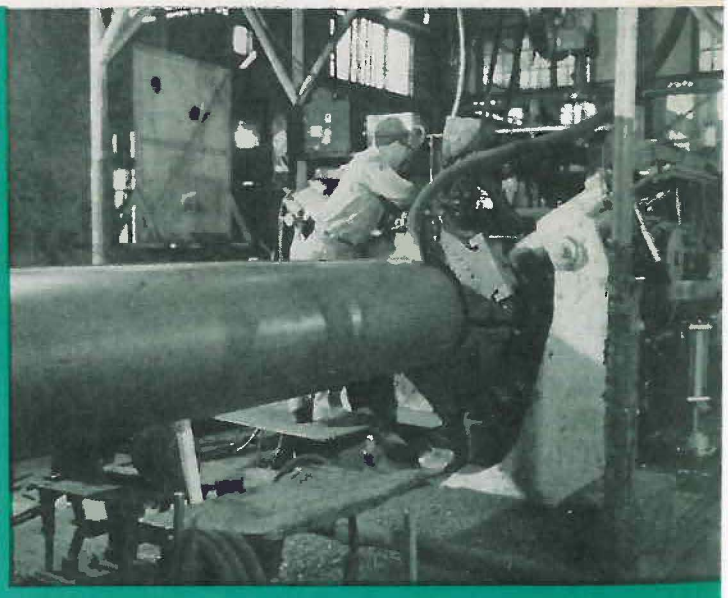
3. *Cold Worked Pipe:* This type of pipe is fabricated by the electric-arc welding method . . . and then is "cold worked" to give it added strength. The pipe is made slightly under the required finished diameter and is then expanded by hydraulic pressure. This cold-working process materially increases the yield strength,* thus permitting the use of thinner wall pipe at a given pressure (and saving approximately 25% on weight). It fully tests the strength of the welded seam at the yield strength of the parent plate, and its expansion into a true cylinder gives uniform roundness, size and straightness in the pipe. Diameters for cold-worked pipe range from 6⅝ to 40 inches.

STANDARDS OF MANUFACTURE AND TESTING

To meet the exacting requirements of those who wish the best type of pipe for transportation of water, fabricators of steel pipe have set the highest standard for its manufacture. Especially significant are the modern testing processes. *Every section of steel pipe is*



Automatic welding machine being set up for internal welding of inside seam on ½" thick plate.

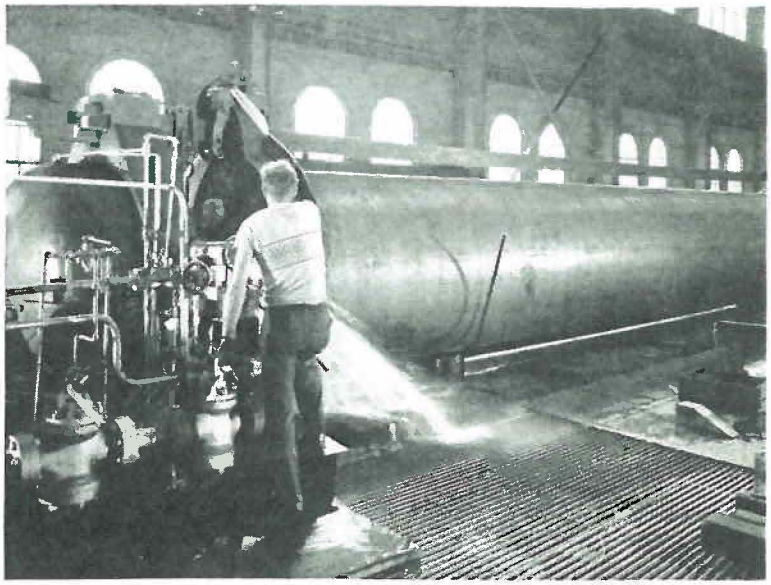


Automatic electric-arc welding machine for exterior welding. Produces welds as strong as the parent metal.

hydrostatically tested in the shop. Water is turned into the pipe and gradually brought up to the testing pressure of two times the working pressure, or according to specifications. Although careful fabrication insures exact conformity to desired specifications, in addition, steel pipe is carefully inspected to insure uniformity of roundness, correct alignment and conformation of pipe ends to specification tolerances.

Fabricators, too, take the greatest precautions to make certain that steel pipe is absolutely smooth and free of any obstructions that might hinder water flow. For most pipe over six inches in diameter, specially-designed machines clean both interior and exterior, preparatory to application of the final protective coatings which provide a smooth flow surface and add many years to the life of a steel pipe installation.

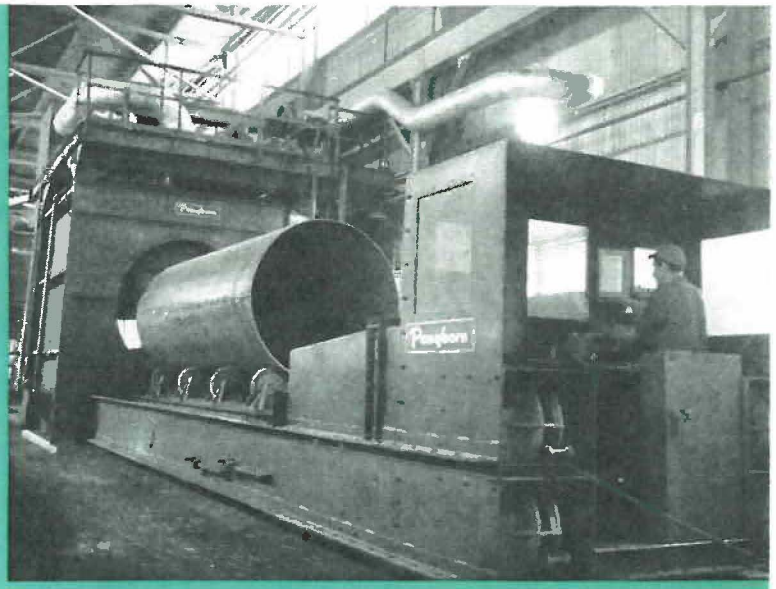
*The stress, measured in pounds per square inch, required to cause steel to deform permanently.



Completing the important hydrostatic test. Each section is placed in this hydrostatic testing machine, where it is subjected to internal water pressure much higher than the actual working pressure of the finished pipe line.

"Wherever Water Flows
STEEL PIPES
IT BEST"

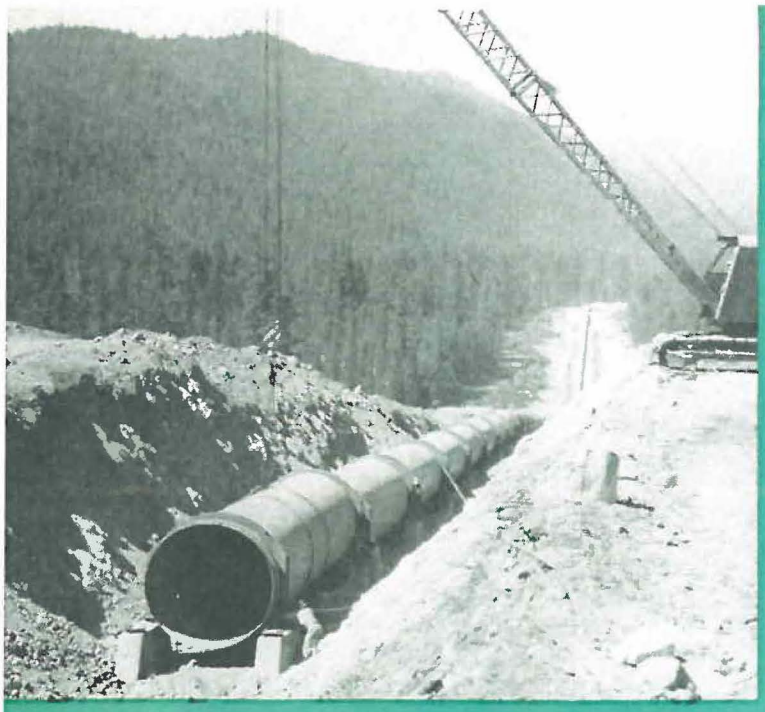
A long section of 36" OD spiral welded pipe emerging from the pipe machine, which forms and welds pipe in a continuous operation.



Pipe about to enter special grit blasting machine for cleaning interior and exterior of pipe simultaneously. Machine will handle pipe up to 40' long and diameters to 84".

Laying large 72" diameter steel water pipe in city streets—note clean ditching and lack of traffic interference.

Field welding of 40 foot sections, large diameter steel water pipe. Note ease of handling with one sling.



Steel pipe being laid under difficult terrain conditions.

Bouquet Canyon Aqueduct, City of Los Angeles. Coal tar enamel applied on interior by hand daubing. Entire line above ground.

ADVANTAGES OF STEEL PIPE

CHOOSING THE MATERIAL

When we say that steel water pipe has "advantages," we mean, of course, that it has attributes which make it a better carrier of water than other types of pipe. Modern conditions, with their mounting demands on materials as a result of stresses, strains and emergency conditions to which they are subjected, make it essential for officials, engineers and contractors charged with the responsibility of designing, building, and maintaining water lines to select the best material. And the material selected should qualify as "best" in *every* way.

Comparison with other commonly used materials reveals that steel water pipe *does* qualify as the best in every essential respect for use in your water system.

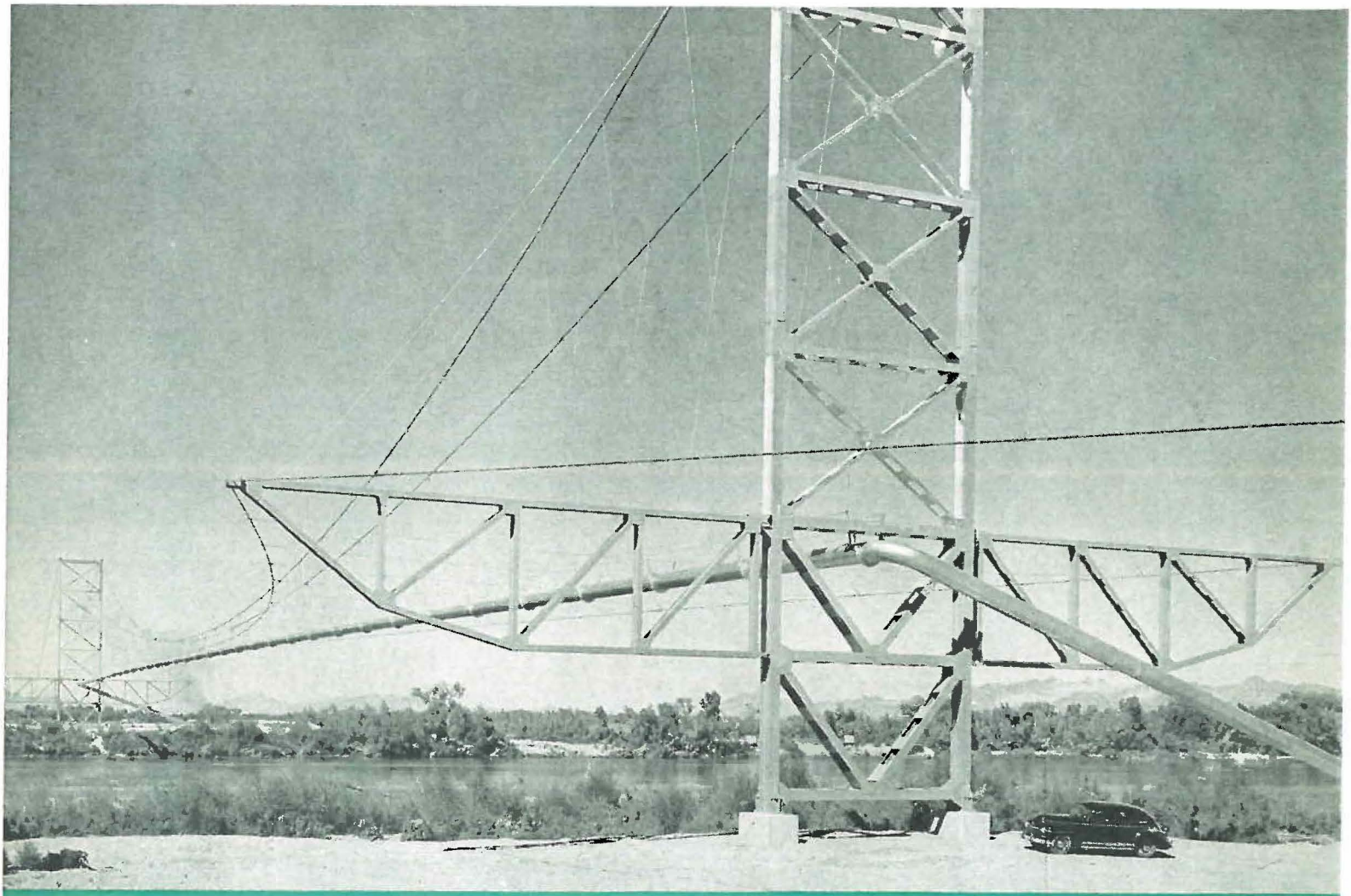
ESSENTIAL REQUIREMENTS

The essential requirements which material for a water pipe line must meet are relatively simple. They can be listed as:

1. Outstanding strength
2. Extreme durability and long life
3. Economy of installation and maintenance
4. High carrying capacity
5. Ductility and adaptability
6. Great reliability and resiliency
7. "Bottle-tight" joints

Steel water pipe answers each of these basic requirements better than any other material now used for water lines. Here is why:

1. An advantage of steel pipe over other materials is its great tensile strength. It stands alone in offering the greatest strength in proportion to wall thickness of any commercial piping material available for use in water lines.
There is no substitute for strength.



1040 foot Colorado River crossing at Blythe, Calif. Second longest of 4 river crossings of this type. An excellent example of beam strength and flexibility of steel pipe.

2. When it comes to durability and long life, steel pipe makes a superior showing among all types of water-carrying materials. Available records show scores of instances where steel pipe has been in service for over 50 years . . . and is still doing a commendable job. Many others have been in use for much longer periods. With the great advances that have been made during the last few decades in the fabrication of steel and perfection of coatings, the useful life of steel pipe can now be conservatively estimated at 100 years or longer.

3. Steel pipe usually costs no more—and frequently costs less—to buy and install, and an all important advantage is the economy of maintenance which characterizes a steel water pipe line.

4. Every water line system needs the maximum possible carrying capacity. Population increases can make a line obsolete quickly unless it can be depended upon not only to have the greatest possible capacity when installed, but to maintain that capacity in use. Properly lined and coated steel water pipe is impervious to corrosion and incrustation. It can be relied on to maintain its carrying capacity. An additional advantage is the wide margin of safety engineered into steel pipe. As a result, it is possible, in the event of greater future demands, to increase the carrying capacity by boosting the pressure, and yet to stay well within safety limits.

5. Of almost equal importance, the extreme ductility of steel water pipe is a unique advantage as com-

pared with other materials. It is this unusual characteristic—available *only* in steel water pipe—which makes possible its wide use in terrain situations where other materials either cannot be used, or can be installed only with difficulty or at additional expense.

6. Reliability is perhaps not so much an advantage as it is a definite necessity in any water line. Once installed, engineers can depend upon steel pipe to do the job for which it was designed. This reliability extends not only to constant carrying capacity, but to its ability to withstand any number of unexpected or emergency conditions. It means resistance to water hammer and to washouts. It includes the *resilience* to "give" under soil movement and immunity to surface vibrations.

7. A requirement of utmost importance which steel pipe fills completely is the necessity for "bottle-tight" joints. No water line can operate successfully and economically without leak-proof joints. Wastage of water can be, as every engineer knows, the most expensive fault of any water system. Here steel pipe excels. Joints in steel pipe, whether welded or mechanical, are completely water tight—and will stay that way for the life of the line.

Finally, steel water pipe lines bring you a bonus advantage in the form of improved public relations . . . an advantage not to be taken lightly. The people of your community will appreciate the better service at lower cost which they receive.

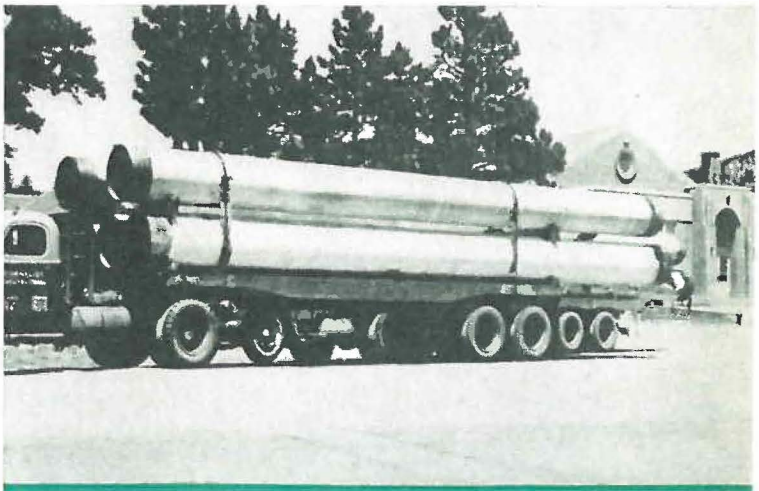
STEEL . . . THE IDEAL MATERIAL

No other material offers all of the requisites for a good conduit—strength, long life, economy, permanent high carrying capacity, ductility, reliability, and "bottle-tight" joints.

Perhaps the major consideration in the selection of pipe material for conveyance of water should be strength without the handicap of rigidity. In this respect, steel surpasses all other materials because it has maximum strength with maximum ductility. The tensile strength* of steel normally used for water pipe is 50,000 pounds per square inch and may go higher if necessary. Because of this great strength and ductility, steel pipe resists suddenly applied emergency pressure, surge, water hammer, earthquakes, traffic vibrations, settlement, cave-ins, washouts, floods, temperature changes, blastings, bombings, and other similar conditions which so easily destroy other types of pipe. This means that, unlike rigid materials, steel not only has great strength but also has the ability and toughness to withstand great shock without shattering.

*Tensile strength is the strength, measured in pounds per square inch, required to pull apart a one-inch steel bar lengthwise.

Added to these major advantages of steel pipe are its many other complementary points of superiority. These include a wide selection of sizes, wall thicknesses and lengths which give you a pipe "custom tailored" for a particular job. Precision fabrication in conformity with A.W.W.A. specifications, and careful testing, provide greater assurance of a satisfactory line. And its longer lengths, combined with considerably less weight than other materials, keep transportation and installation costs at a minimum.



Truck load of coated and wrapped 30" diameter steel pipe, showing method of securing for transport so as to prevent damage.

RESULTS TELL THE STORY

Whatever your basic interest, steel pipe will give you superior results:

1. *For the owner*, its nonporous structure and its leak-proof joints mean that profits won't seep away due to leakage. Rates won't need increasing to help pay for water wastage. Because of steel's ability to stand shock and vibration, costly damage claims resulting from sudden pipe failures will be eliminated. These factors will improve public relations and customer goodwill—with no increase in cost of installation.

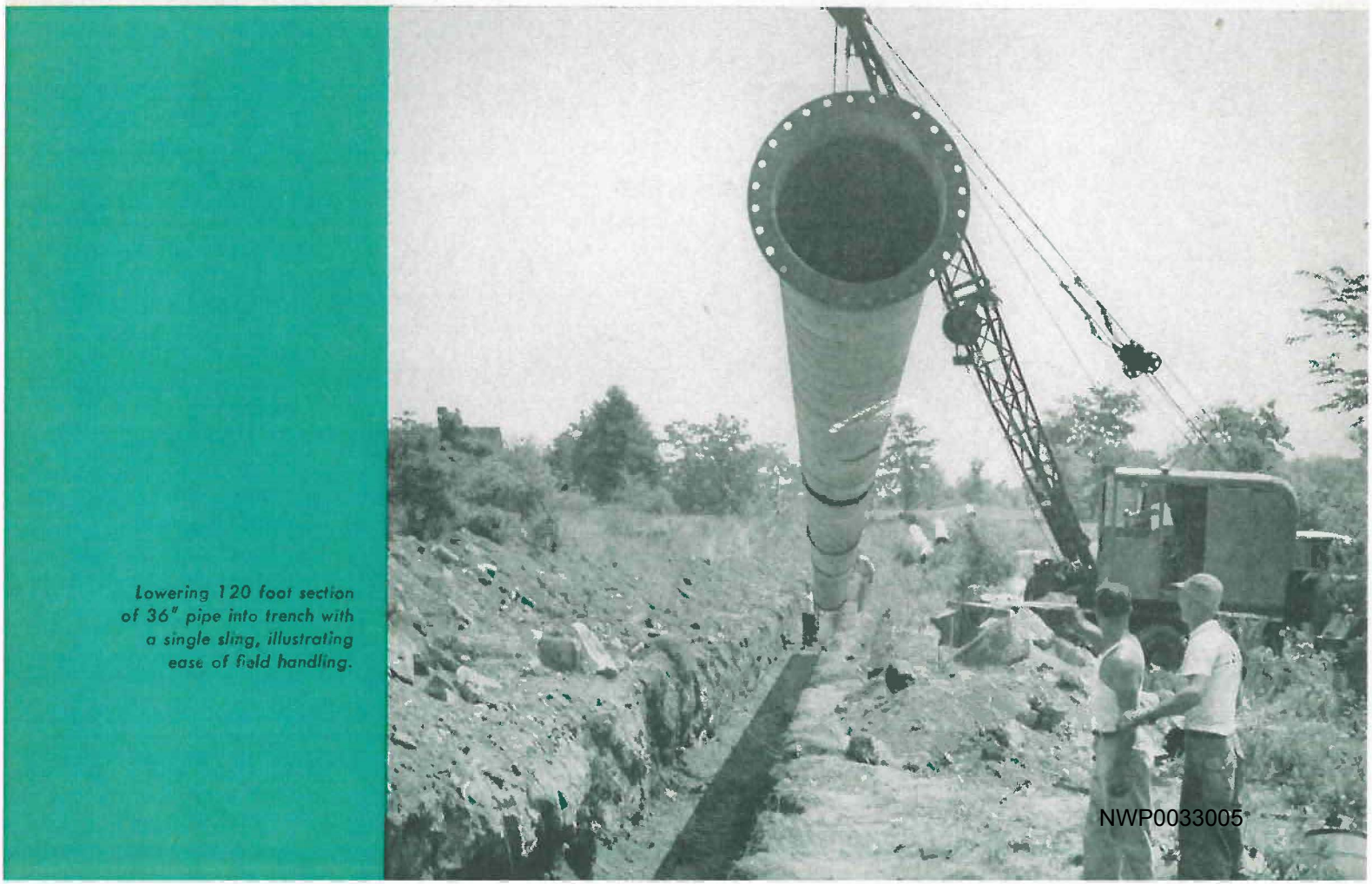
2. *For the design engineer*, the many different diameters and thicknesses available minimize design problems. The fact that steel pipe will withstand such a wide range of pressures again reduces design problems. The factor of safety for steel pipe is usually three or more against bursting, whereas with pipe of rigid material it runs far less, sometimes as little as 1½. This means that a steel line designed for a specific rate of flow can—should it become necessary—deliver much more water by simply increasing the pressure, yet still maintaining a reasonable safety factor. And because each length of steel pipe is thoroughly tested for strength, the engineer can be sure he will get what he pays for.

3. *For the construction engineer*, the longer lengths available in steel water pipe are especially important because they mean fewer field joints. For example, 40 foot lengths of 48″ steel pipe, fabricated to withstand over 200 psi, require only about 132 joints per mile as compared to 300 or more joints required by pipe made in 16 foot lengths. In addition, the 40 foot length of steel pipe weighs approximately 7,000 pounds, whereas a 16 foot length of the same pipe in concrete weighs about 15,000 pounds—and will withstand only 180 psi. This means steel not only requires fewer field joints, but permits using lighter field equipment to lay the line—and a good chance of saving thousands of dollars in installation costs!

4. *For the operating engineer*, steel pipe's leak-proof and shatter-proof characteristics mean fewer operating troubles. It is impossible to have sudden and complete failure of a properly designed steel pipe line thus eliminating costly emergency calls to repair "breaks," flooded sub-surface structures, and cave-ins.

5. *For the "average citizen,"* a steel pipe water line means no streets washed out—no interruption of service—lower water rates, and a saving in his tax bill. And his investment is doubly protected because it is possible to so design the line as to provide for future increased requirements as well as present.

Thus we have in steel pipe as a result of both its basic characteristics, the expertness of manufacturing processes and the exhaustive tests to which it is submitted, the ideal material for the conveyance of water in any size pipe.



Lowering 120 foot section of 36″ pipe into trench with a single sling, illustrating ease of field handling.

DUCTILITY AND ADAPTABILITY

One of the primary requirements to be considered in selecting the type of pipe for water systems is its ductility, and its adaptability of use.

Here steel offers one of its major advantages over other materials. Both in ductility and in adaptability of use, steel pipe completely outclasses other types.

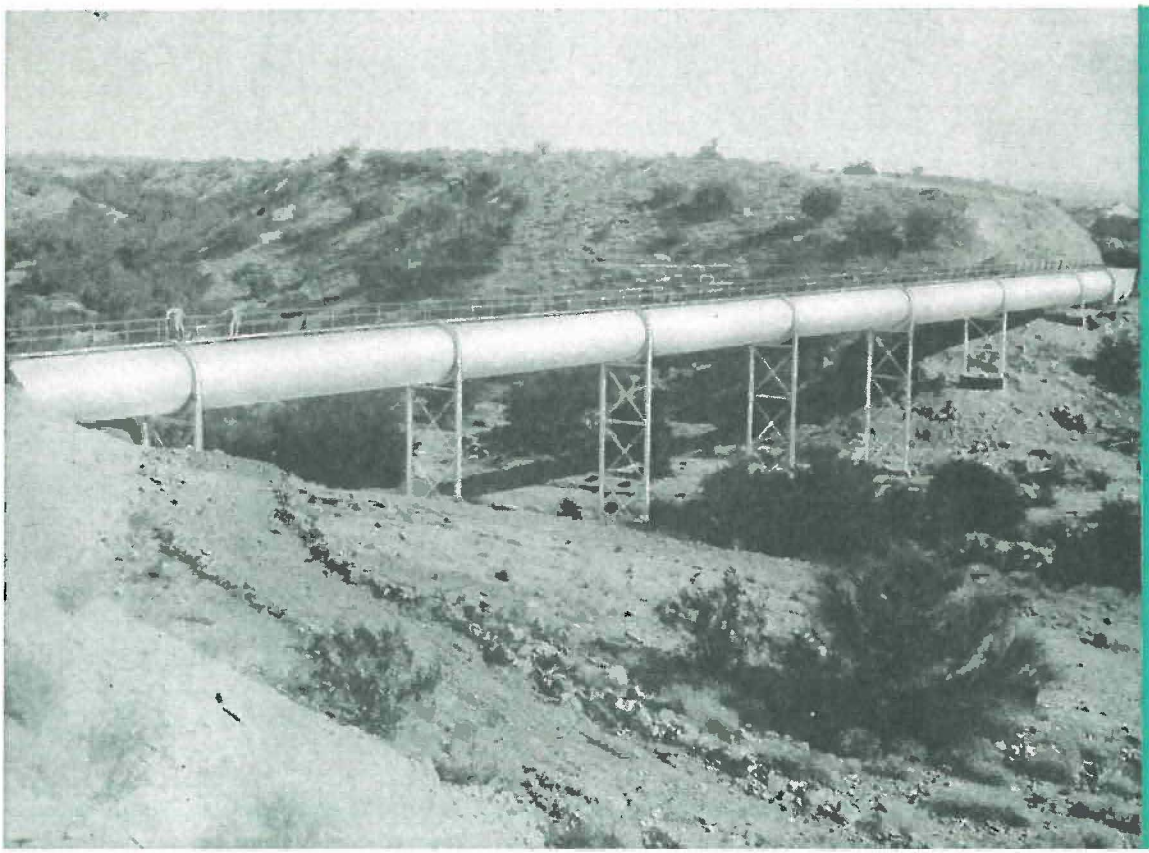
DUCTILITY

The basic characteristics of steel pipe manufactured from ductile, mild steel, eliminate the probability of the structural brittleness which is a characteristic of many other materials. This fact is borne out by engineering statistics, which show that steel pipe has an elongation factor of at least 18%—more than sufficient to take all ordinary stresses and strains without breaking. As a material, steel can be rolled, formed, welded, forged, or cast. Types and shapes of pipe fittings that can readily be made are infinite in number, which means that all common and special requirements can be met easier with steel pipe.

It is this ductility which permits it to "live in the ground" secure against the normal settling and shifting of problem soils.

It is also this property of ductility which gives steel pipe the ability to withstand such abnormal shocks as surge, water hammer, earthquakes, cave-ins, washouts, floods and extreme temperature changes without cracking, shattering or leaking. Man-made abuses such as traffic vibration, blasting, and extreme pressure, are as easily conquered.

Examples of the great ductility of steel pipe are numerous. At Bakersfield, Calif., as a result of the earthquake of 1952, over 80,000 feet of another type of pipe ruptured and was replaced by steel, while at the same time steel pipe laid 3 feet underground was forced up through the earth by the quake, with more than 100 feet of pipe arching some two to three feet above the ground surface. This pipe remained service-

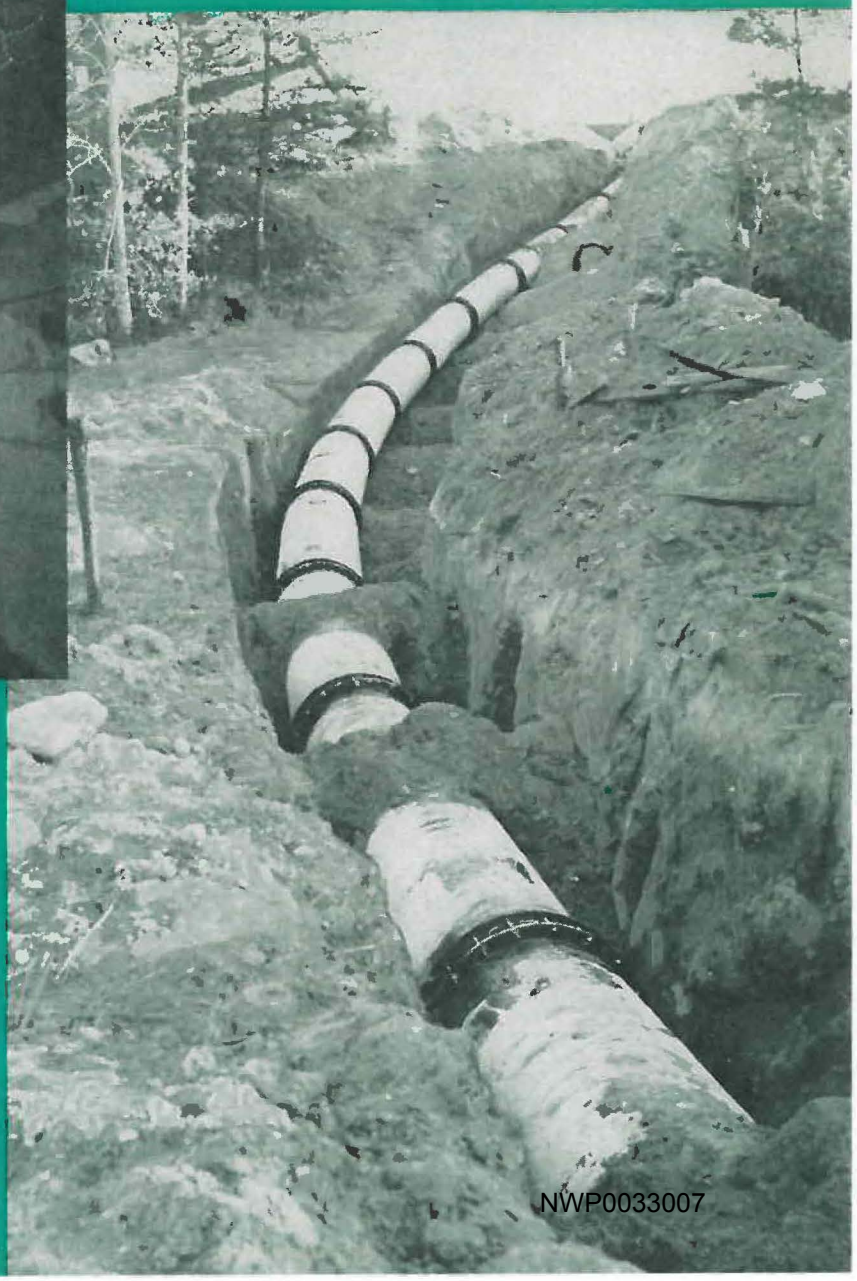


120 inch diameter, ¼ inch wall thickness, welded steel pipe supported by ring girders and steel bents on 60 foot centers. Maricopa County, Ariz.

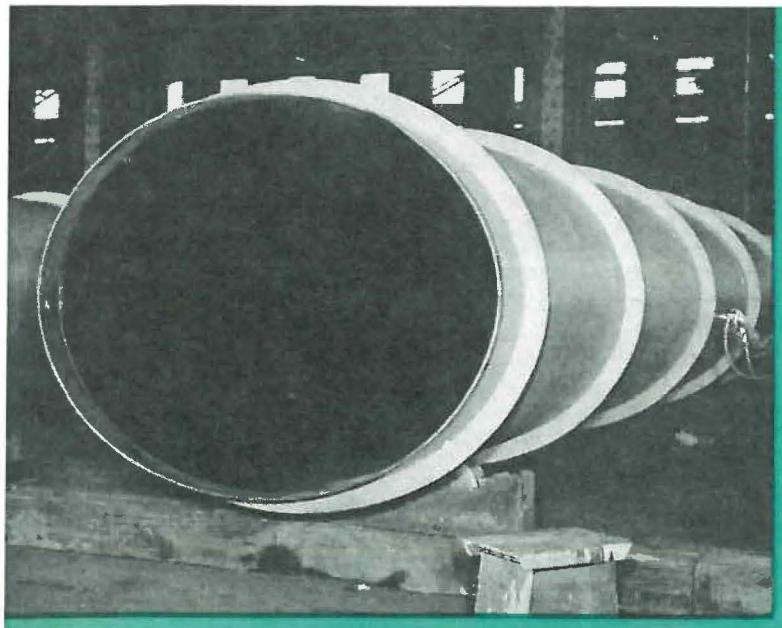
48" and 54" water lines laid along city streets in Philadelphia showing ease of following street contours.

Steel water pipe line following curve of railroad—note long sections, straight lengths, and mechanical couplings.

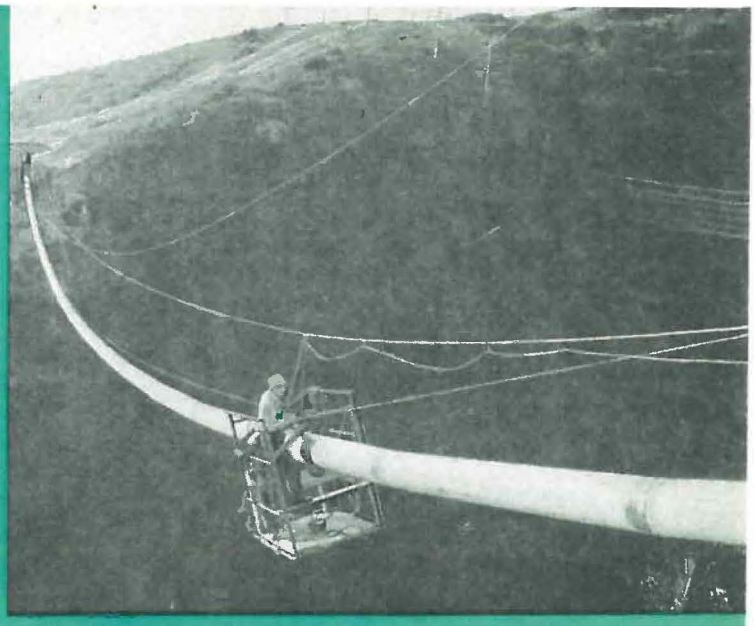
Steel water pipe lines serve in air conditioning the Capitol, Library of Congress Bldg., Supreme Court Bldg. and wing of Senate Office Bldg. in Washington.



Steel water line, Greensboro, N. C. Long radius bend made with straight lengths of pipe and couplings.



Welded steel elliptical pipe, 66" x 83" x ½" plate—spun coal tar enamel inside. An example of flexibility of design to meet restricted headroom.



Steel pipe line—16" in diameter—suspended across a 420 foot Canyon near Ventura, Calif. An excellent example of adaptability and strength.

able without developing a leak, and was eventually returned to its original position.

The resistance of steel pipe to washout is illustrated by an instance in which a group of piers were washed away from under 10′ diameter x ½″ thick steel pipe full of water, leaving an unsupported length of 115 feet. The deflection at the center of this unsupported span amounted to only 3½″, and the pipe did not break.

An exceptional feature of steel pipe which further illustrates its ductility is its capacity of being restored to service even after damage due to stronger abuse. There have been extreme examples in which large diameter steel pipe lines, installed above ground, after having collapsed under unpredictable vacuum conditions, sabotage or floods, were restored to their original condition by merely filling the pipe with water and rounding it out under pressure.

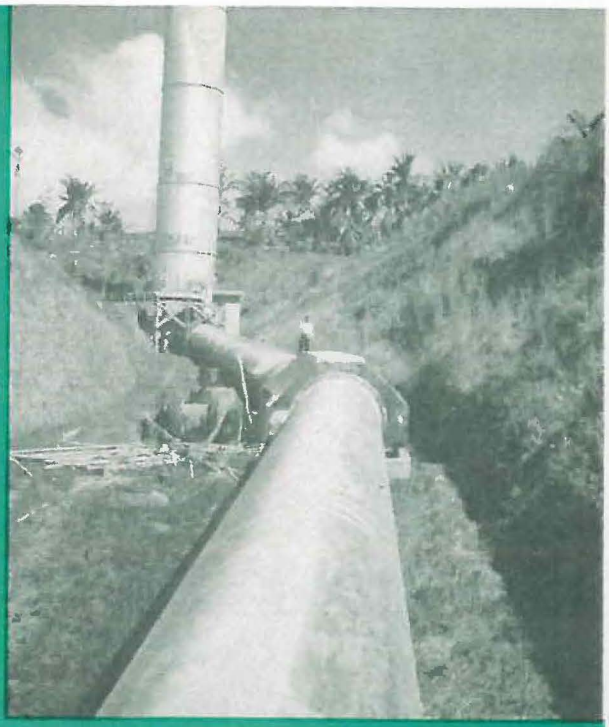
ADAPTABILITY

The physical flexibility or ductility of steel water pipe results in an equal flexibility in its wide variety of uses, especially in difficult terrain situations. It can be installed under water, in mud, clay, quicksand or peat bog, or tunneled under highways or existing pipe lines. It is the only type of pipe that can be laid above ground with confidence because it is so resistant to external damage.

Steel pipe can be installed on steep, rugged slopes, such as canyon walls, or down the sides of mountains. It is the only pipe capable of being supported over swamps on widely spaced piers by integral ring girders. Another example of its adaptability is the ability to be carried across wide canyons on flexible suspension bridges. In fact, steel pipe is the invariable choice of engineers when the going is the toughest.

The great variety of thicknesses, high physical properties, and sectional lengths in which steel pipe is available, enable the engineer to design his pipe line more accurately to meet whatever conditions he may encounter

"Wherever Water Flows
STEEL PIPES
IT BEST"

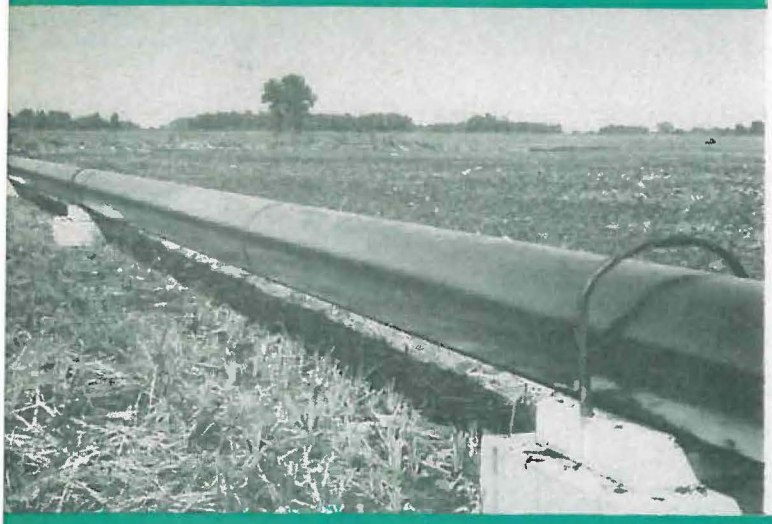


Section of large steel water pipe line near Manilla, P. I. which was intentionally collapsed to prevent use by Japanese. It was later restored to original shape by pressure, and is shown in use today.

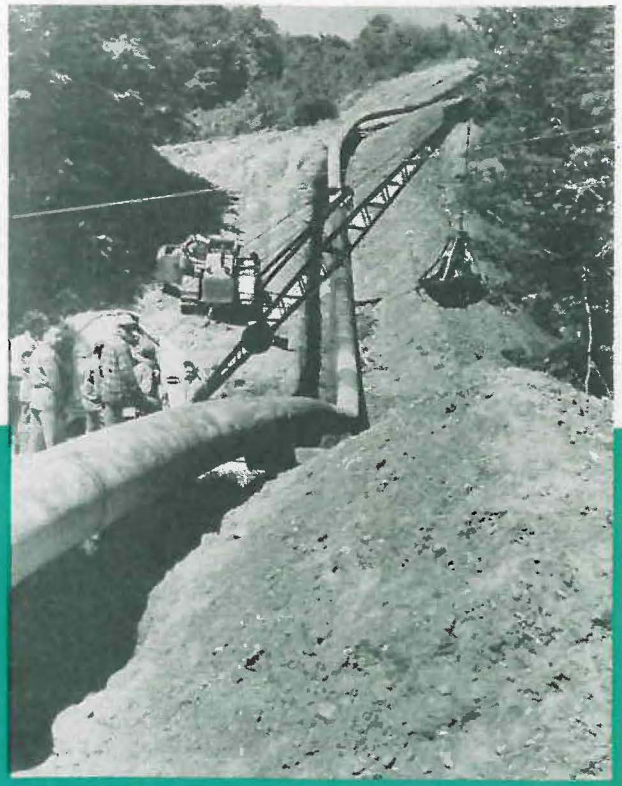
Steel pipe can be "shop fabricated" to meet the specific requirements of the field. If special fabrication in length, fittings or accessories is needed, it can be applied quickly and economically, yet "tailor-made" for the particular job.

Ease of transportation to and over difficult terrain, as compared with other heavier materials, adds to the factor of adaptability and represents a definite saving both in time and expense. For example, a section of lined, coated and wrapped 60″ x ⅜″ thick steel water pipe 40′ long weighs less than 12,000 lbs., whereas a comparable section of concrete pipe only 16 feet long weighs approximately 11 tons. Once in the field, steel pipe is easily handled and jointed—again resulting in a saving of installation cost. Due to its flexibility and strength, steel pipe can be assembled and joined in long lengths, above the trench, and then lowered into position. This is not possible with any other pipe material in use today.

Ductility and adaptability to job requirements—are major contributing reasons for the rapidly increasing use of steel water pipe by water works engineers and contractors across the country today.



24″ line crossing swampy ground, illustrating beam strength.



Steel pipe in rugged terrain—illustrating adaptability to any contours.

"Wherever Water Flows
STEEL PIPES
IT BEST"

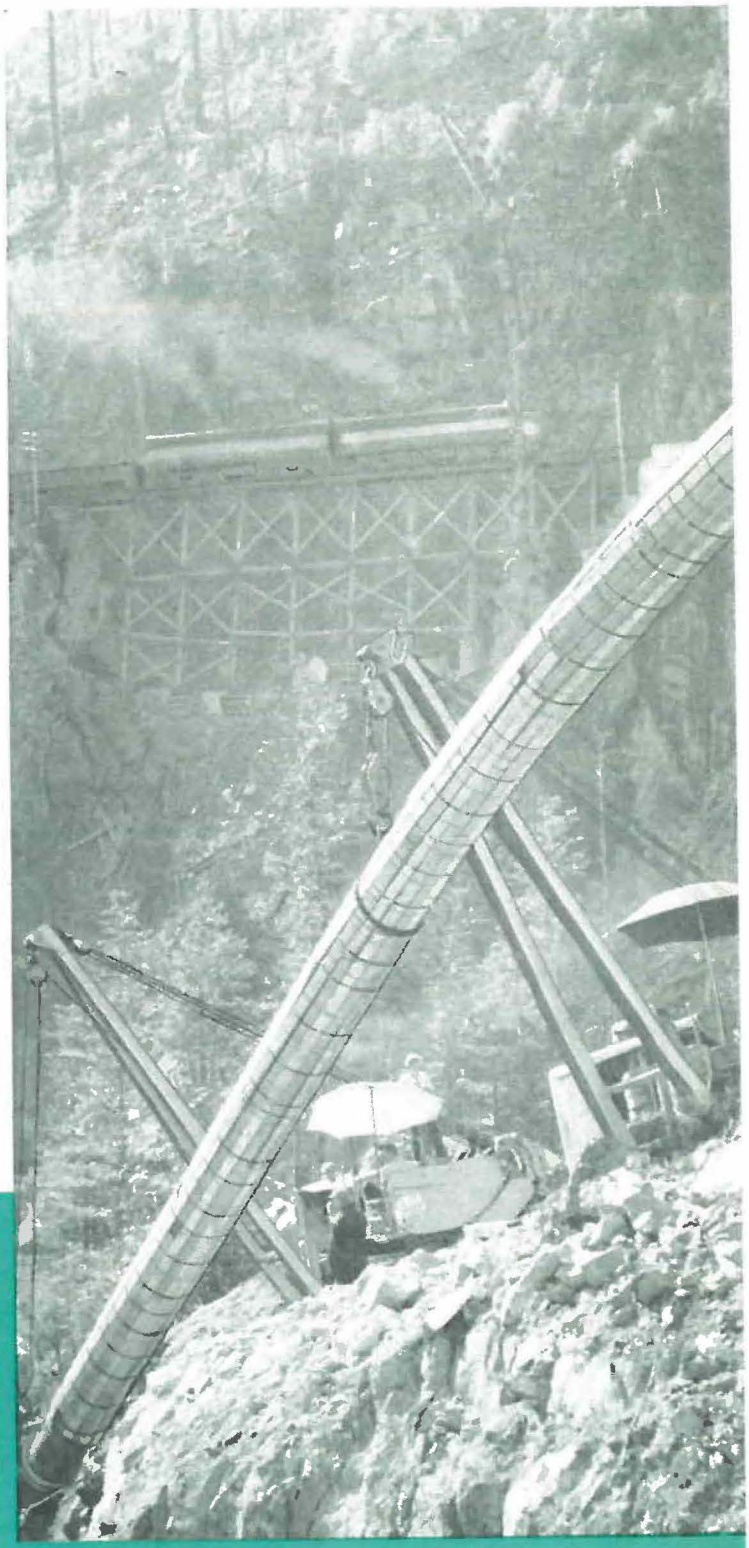
INSTALLATION ADVANTAGES OF STEEL PIPE

Steel water pipe has many positive advantages in transportation and field installation work.

The basis for these advantages is the fact that steel pipe possesses the greatest strength per unit weight of material of all types of water pipe. Therefore, for a given pressure, steel pipe will have the lowest weight per foot as compared to any other type of pipe.

This relative lightness reduces the cost of transportation from the shop to the job site, and permits lighter equipment being used. Handling of steel pipe in loading and unloading is expedited, particularly in rough or wet country. Because of this ease of handling, the cost of laying the pipe is reduced. The necessity of fewer field joints, as a result of the long lengths of pipe sections, and the availability of various types of flexible and water-tight field connections is of equal importance. All of this adds up to fast laying operations and overall economy.

Another advantage of using steel pipe is the saving which may be made in excavation and backfill operations over other types of pipe. This is possible because the clearance required for laying work in the trench is usually less than for other pipe. Therefore, a narrower and shallower trench can be used, which reduces to a minimum the amount of excavation, backfill, and bell holes required for the water line. Further savings are realized throughout the life of the pipe in the form of lower interest charges, no leakage losses, and a minimum of maintenance costs, when properly designed, constructed and protected.



A 24" line being lowered over a cliff in mountainous territory. The pipe is protected by wooden slats to prevent damage to coating.

Thus the installation advantages of steel pipe over other types used for water systems can be summed up as follows:

1. Lower hauling or shipping costs.
2. Easier handling.
3. Fewer sections to handle.
4. Least number of field joints
5. Fewer bell holes.
6. Lower equipment costs.
7. Minimum of blocking.
8. Greatest flexibility in meeting field conditions.
9. Minimum amount of excavation and backfill work.
10. Greatest speed in laying operations.
11. Minimum maintenance costs.
12. Greatest economy.
13. No leakage or infiltration.
14. Greater protection of health of water users.

Eight 40 foot lengths of 36" diameter steel pipe—total weight 51,200 lbs. loaded on standard flat car.

Field coupling. Note narrow trench and long length of sections.

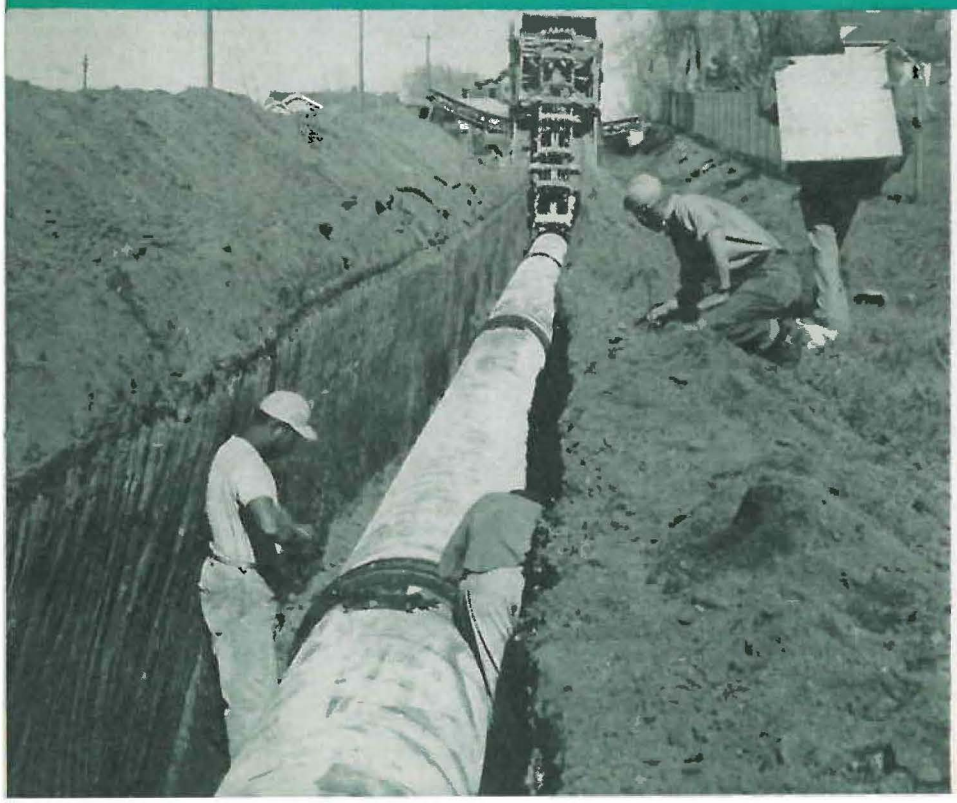
Laying steel water pipe in Cincinnati street—note narrow trench and fast follow-up behind excavator.

78" steel pipe being laid. Note narrow trench. Eighteen 40 foot sections of this pipe were laid in 8 hours on this job.

Illustrating ease of handling and minimum need for manpower in laying 40 foot sections of 50" steel water pipe.

Underwater river crossing of 36" steel pipe line coupled and harnessed into 63 foot lengths in shop for delivery to job site. Pipe has coal tar lining, coating and wrapping.

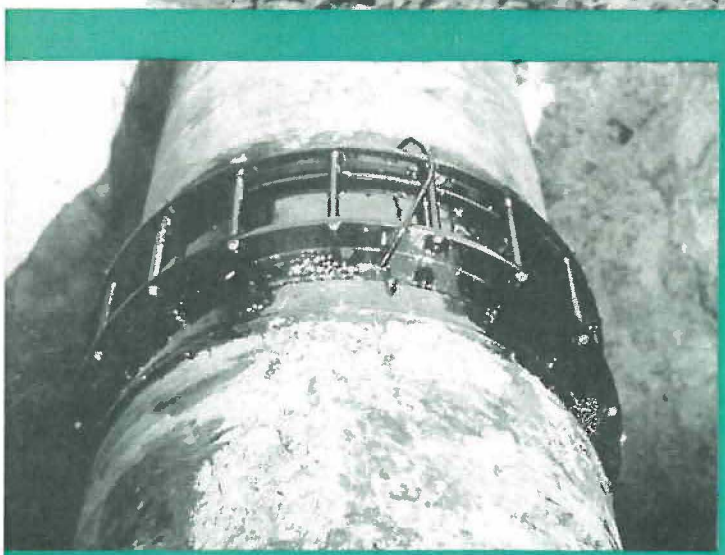
Example of narrow ditching in Portland, Oregon. Note also light equipment and ease of handling



Ditching and laying simultaneously with joints completed only three sections from ditcher.

"Wherever Water Flows
STEEL PIPES
IT BEST"

NWP0033012



Close up of mechanical coupling after application of protective coating.

Coupled, lined, coated and wrapped steel water line laid in rugged terrain, installed for U. S. Bureau of Reclamation.

FIELD JOINTS

No water line is stronger than its joints. Steel pipe has the distinct advantage that *100% bottle-tight joints* are assured.

Allowance for leakage at joints is eliminated where steel pipe is specified. This means conservation of vital water, full advantage from the designed capacity, protection against washouts and costly joint maintenance.

Joints in steel water lines are fewer, because of longer pipe lengths; and generally easier and faster to install. They lend themselves to good work organization, provide uniform quality and trouble-free performance. They test tight and stay tight.

MECHANICAL COUPLINGS

Dresser Couplings are the most widely used mechanical joints on water lines. Their rubber-pack seal and built-in flexibility provide unique advantages in field installation of steel pipe. Deflections at joints are accommodated by the coupling, allowing many curves to be accomplished without specials or field bending of pipe. Expansion-contraction stresses are absorbed in the coupling, an advantage of particular importance in above-ground installations and in connections to valves, fittings and machinery. With Dresser Couplings, no beveling, grooving, belling, or exact cutting is required. Perfect alignment of pipe ends is not necessary to effect a permanent seal. No damage to lining takes place during installation, since there is no heat applied. In addition to regular couplings, Dresser mechanical joints are available in reducing sizes for joining steel to cast iron and for radical reductions in steel pipe sizes.

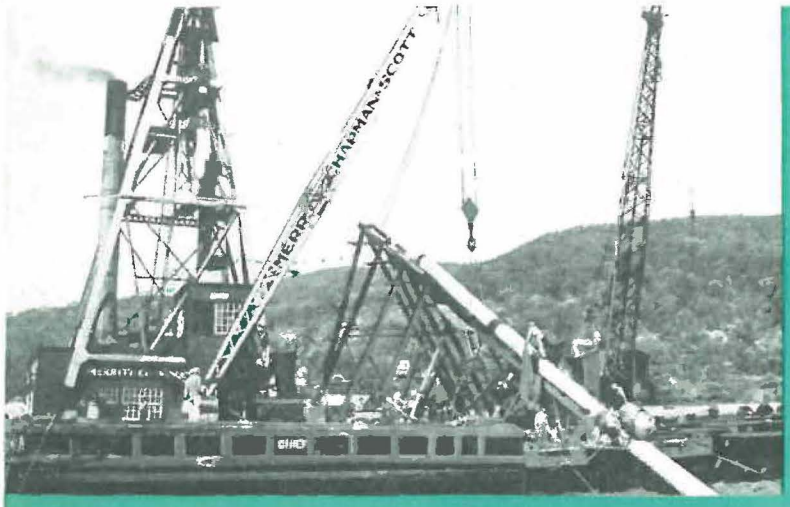
FIELD WELDED JOINTS

A common field welded joint is the single butt weld where ends of pipe are joined by laying a weld around the outside circumference of carefully butted pipe ends. Where qualified welders are available and adequate inspection techniques can be employed, this type of field joint offers superior strength since the pipe, in effect, becomes a continuous structure.

Other types of field welded joints include the double welded butt joint, where a second bead is laid on the inside, and slip bell joints which are welded at the end of the lap and sometimes also on the inside of the pipe. Relatively expensive butt strap joints are employed where unusual circumstances dictate special fitting up of large pipes above-ground.

DRIVE JOINTS

Drive joints are used generally for light gauge low pressure steel pipe under 30" diameter. A slight bell at one end is heated until it expands. The plain end of the next pipe is driven in to a full seat. When the expanded bell cools, it contracts, making a tight joint, which is further sealed by the protective coating, sufficient to withstand 150# pressure.

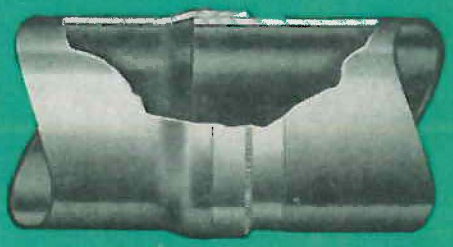


Three 40' lengths of 24" pipe, welded into a single 120 foot section for underwater crossing. The section has been placed in a sloping pipe skid which will guide it toward the river bottom.

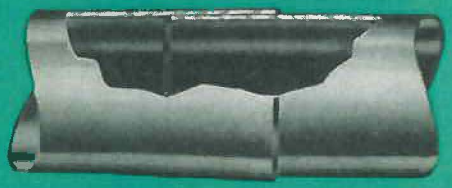
Placing the gasket in position to assure a leakproof flexible joint.

Butt welded field joint, welded outside and inside.

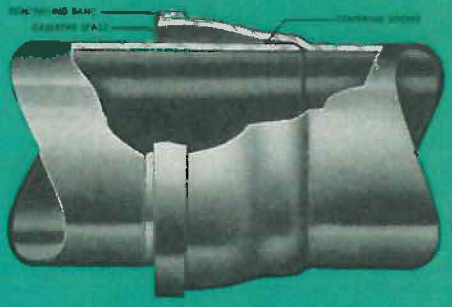
Butt welded field joint, welded outside only.



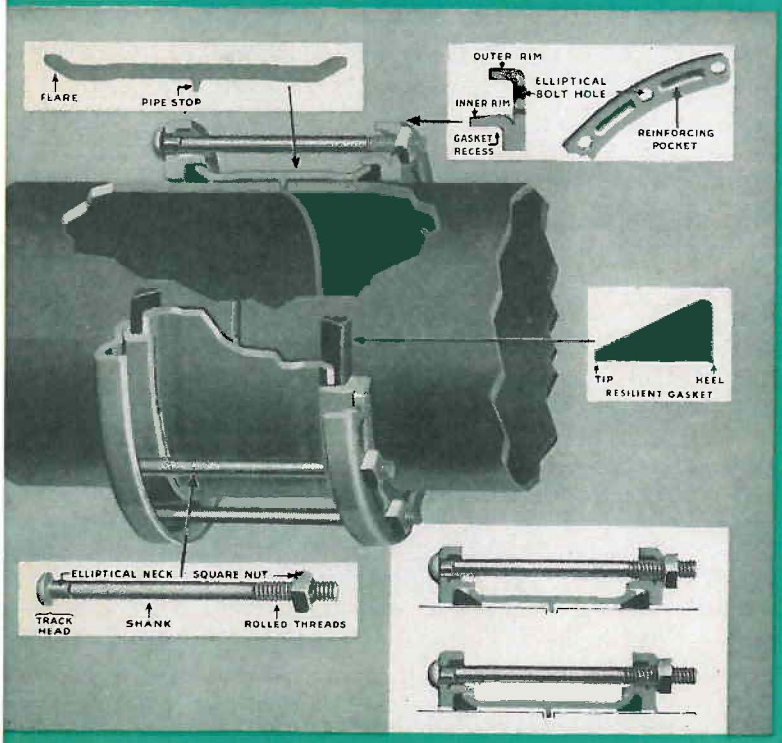
Lap welded field joint.



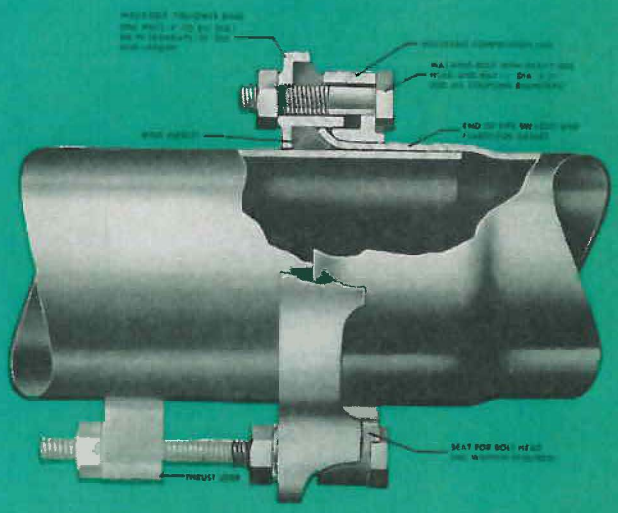
Driven field joint.



Caulked field joint.



Cutaway view of Dresser steel coupling. Picture in lower right hand corner shows position of gasket before and after tightening.



Bolted field joint.

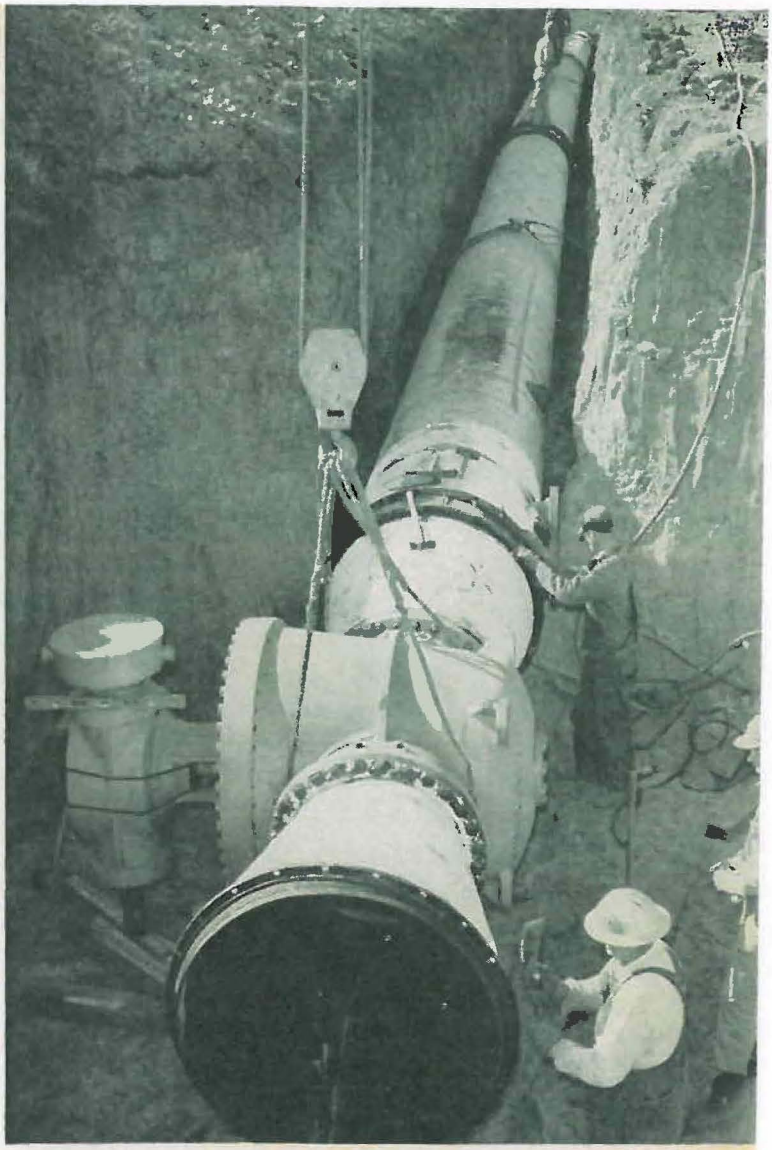
FLANGED JOINTS

This type of joint consists of flanges welded on the ends of pipe, bolted together and sealed with a gasket. It is used for connections at valves, fittings and machinery and provides a rigid connection. Close pipe fitting and line-up is necessary with flanged joints. Main advantage of this type joint is that it affords relatively easy access into the line for removal of valves, pumps and other equipment for servicing.

SPECIAL COUPLINGS AND FITTINGS

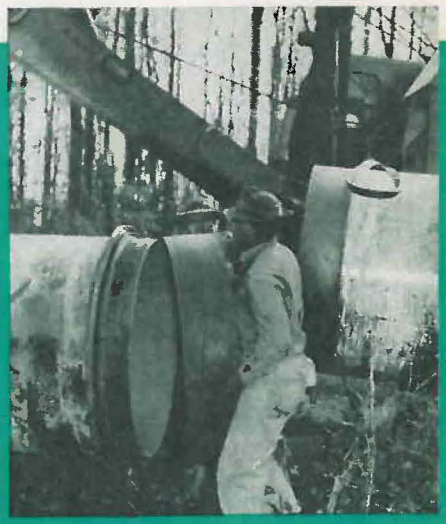
One of the definite advantages of steel pipe is that it is readily adaptable to the construction of fittings and junction pieces required in a pipe line. This feature is especially valuable when mechanical couplings are used. While standard couplings will meet most requirements, certain applications may arise where joints of special design are needed. Mechanical joints are particularly adaptable to the solution of special joining problems and are available in tees, ells, wyes and line caps.

A great variety of appurtenances such as air valves, gate valves, blowoffs, man-holes and pass-holes and expansion joints and anchors, is readily available for use on steel pipe water lines when needed.

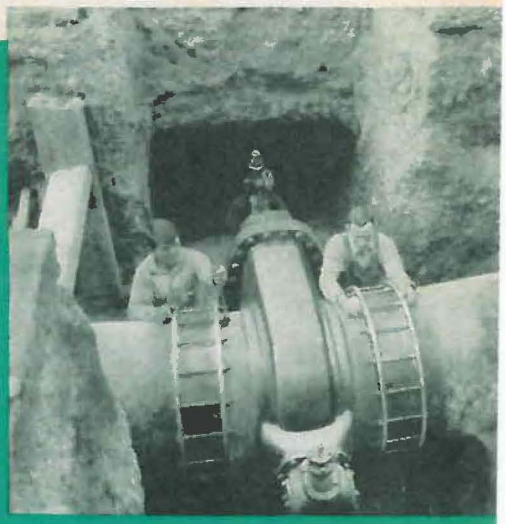


Valves are easily set in steel water lines using mechanical couplings. Narrow trenches required mean minimum excavation.

Butt welding sections of 60" diameter coated and wrapped welded steel pipe. This is a major water supply line for the city of San Francisco.

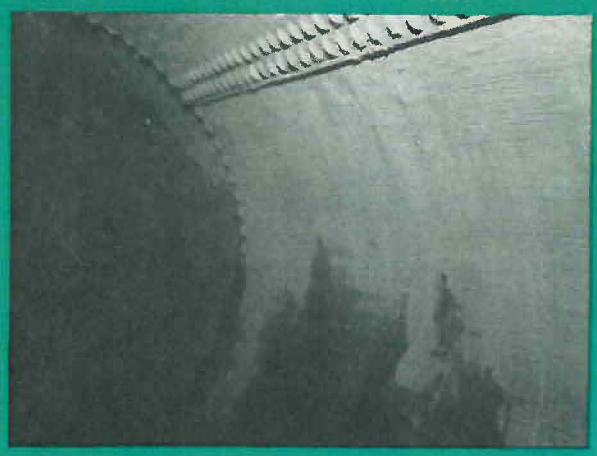


Putting on middle ring of mechanical coupling.



A 48" valve setting with mechanical coupling.

Lining a 40 foot length of 96" steel pipe with coal tar enamel at the fabricating plant.

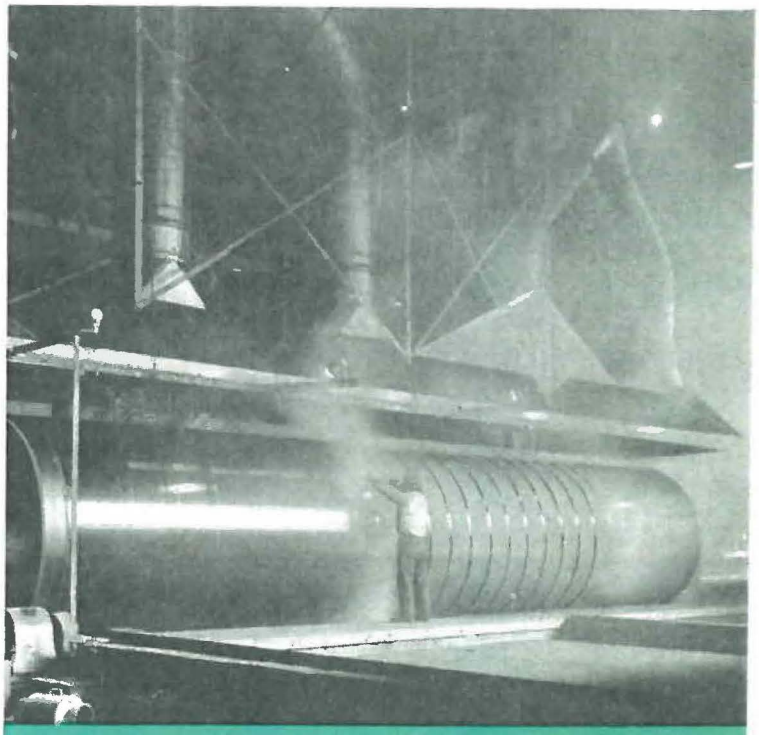


Interior of 48" pipe after 28 years' service. Interior and exterior were hand brushed with coal-tar enamel. Samples analyzed in laboratory showed no change in physical characteristics and no moisture absorbed in the 28 years of use.

Section of coal-tar enamel coated pipe with coating cut away to expose pipe which was laid in "hot" soil, with heavy acid content 10 years previous. Note that exposed pipe is in perfect condition.

Interior view of steel water pipe lined with coal-tar enamel, showing high gloss achieved by the spinning process and resulting in a very high flow co-efficient.

PROTECTIVE LININGS AND COATINGS



Application of coal-tar enamel simultaneously with asbestos felt wrap.

Specially prepared and applied protective linings and coatings are recognized as beneficial to the efficiency, life and operation of a steel pipe water line. These linings and coatings are properly formulated to permanently resist all of the corrosive factors which may be encountered.

The product selected for the protection of the pipe must, therefore, meet all of the five major requirements of an effective lining and coating material. It must have:

1. High resistance to moisture penetration.
2. High electrical resistivity.
3. High resistance to soil acids, alkalis, and salts.
4. High physical stability.
5. High resistance to dissolution in water.

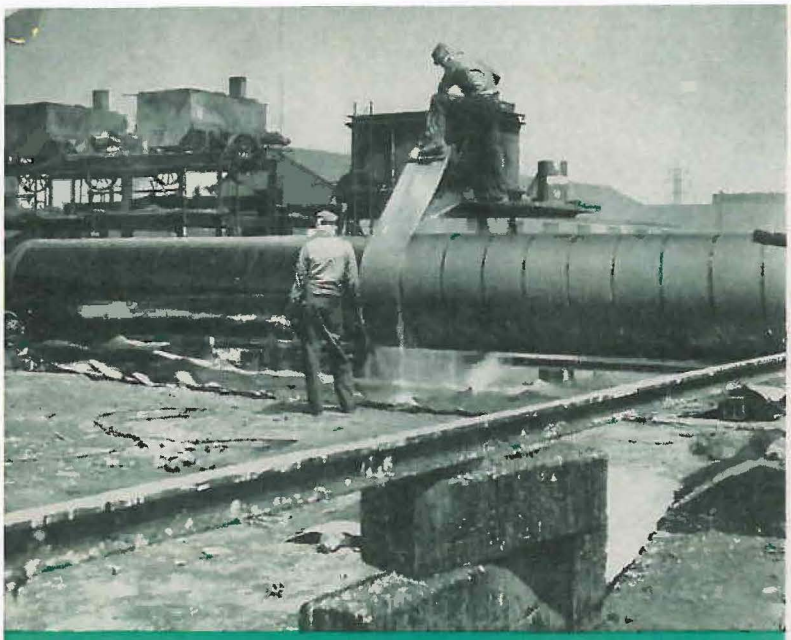
In addition to these very basic requirements, the material selected should have other important characteristics. These include high mechanical strength, durability, smoothness (for lining), permanent flexibility, ease of application, high bond strength, no effect on water quality, and, of course, reasonable cost. It should, to the greatest degree possible, offer resistance to soil stress, stray currents, bacteria, vegetation, abrasion, freezing and erosion.

Among the linings, coatings and wrappings used at the present time are: coal-tar enamel, asphalt, cement mortar and asbestos felt. Each has advantages which must be considered in the light of conditions to be met in the pipe installation being undertaken. The most commonly used lining and coating is coal-tar enamel, for which the A.W.W.A. has developed standard specifications, C203 and C204.

During the last fifty years, coal-tar enamel coatings and wrappings have been used successfully to protect the exterior of thousands of miles of steel pipe lines carrying water, natural gas, and oil.

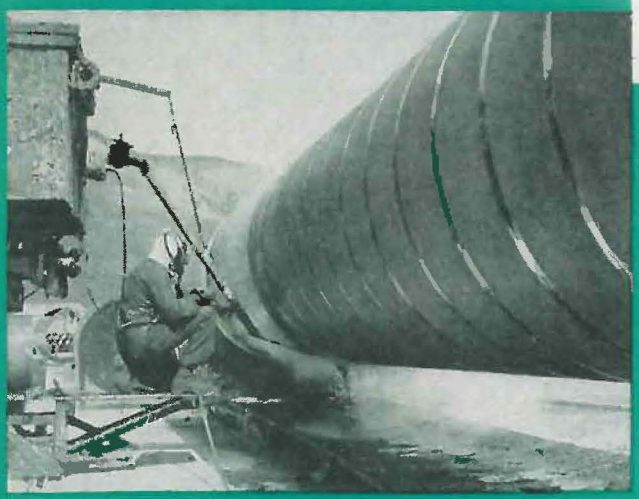
While it requires reasonable care in application, once properly applied, it is universally recognized as providing effective, economical and long-life protection.

A spun application of coal-tar enamel provides the interior of the steel pipe with a lining which is the smoothest waterproof surface currently available. The lining of coal-tar enamel has a thickness of approximately 3/32 inch. Consequently, there is practically no encroachment on the internal diameter of the pipe. Because of these attributes, steel pipe with a spun coal-tar enamel lining has the highest flow capacity of any type of water pipe.

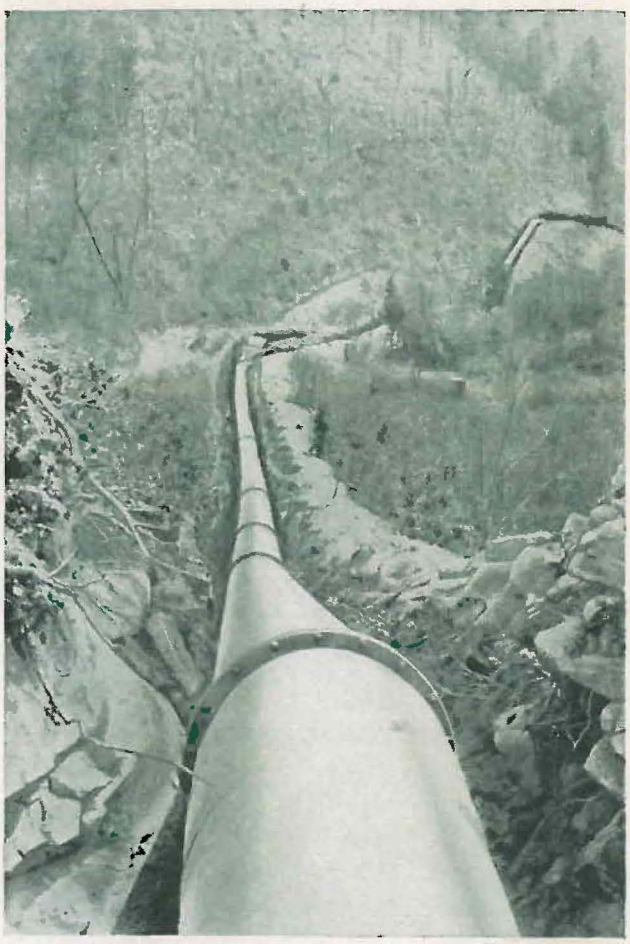


Applying coal-tar enamel and wrapping to 48" pipe in the field.

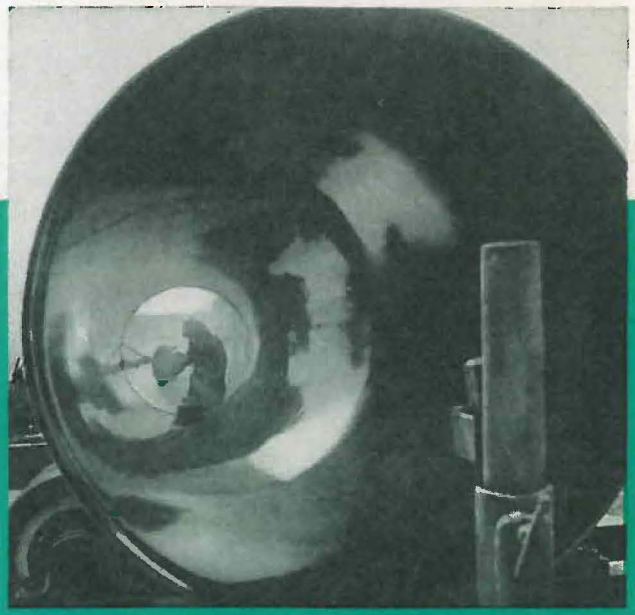
Workman pouring protective coal tar enamel coating on mechanical joint.



Asbestos felt wrapping on 61" x 3/8" wall welded steel pipe.



Part of a 10 mile 30" steel water pipe line near Tamaqua, Pa., The first project to use spun coal tar enamel lining, installed in 1931. A recent check shows no reduction of high flow capacity, "C" equals approximately 145, and no deterioration of coating.



Inside enameling, large diameter steel pipe for San Francisco water line

SPECIFICATIONS

When designing your steel pipe line refer to the following American Water Works Association Specifications.*

C201—Standard Specifications for Electric Fusion Welded Steel Pipe of sizes 30 inches and over.

C202—Standard Specifications for Steel Water Pipe of sizes up to but not including 30 inches.

C203—Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe sizes 30 inches and over.

C204—Standard Specifications for Coal-Tar Enamel Protective Coatings sizes up to 30 inches.

C206—Standard Specifications for Field Welding of Steel Water Pipe Joints.

C207—Tentative Standard Specifications for Steel Pipe Flanges.

C208—Standard Dimensions of Steel Water Pipe Fittings.

When requesting bids or placing orders the above specifications should be supplemented with the following details:

(1) Nominal inside or outside diameter of pipe.

(2) Thickness of steel plate material.

(3) Grade of steel plate material.

(4) Laying length of pipe sections.

(5) Working water pressure for each diameter and plate thickness of pipe.

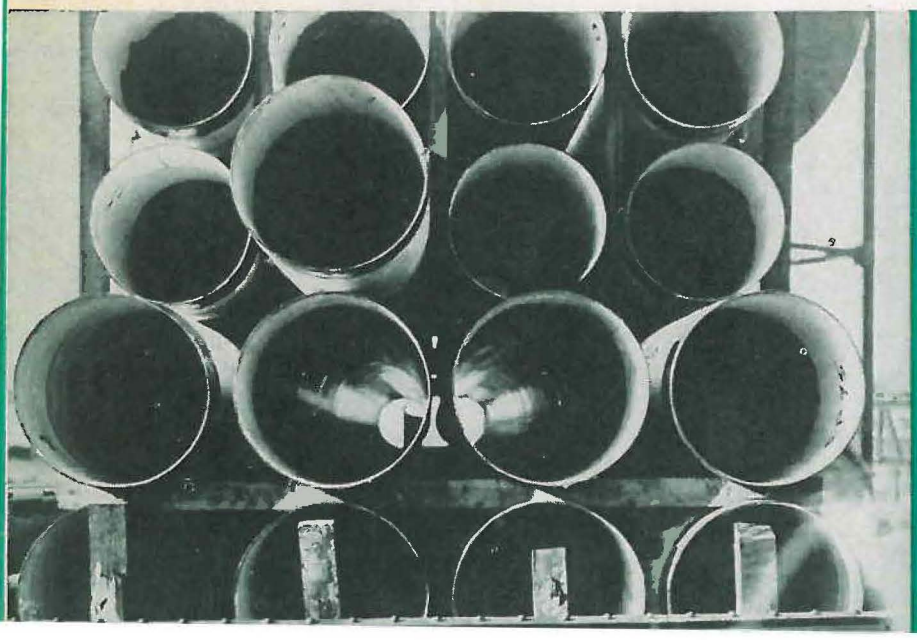
(6) Type of field joints desired.

(7) Alignment and profile of water line.

(8) Type of protective coating and lining.

(9) Destination.

*A.W.W.A. Specifications may be obtained from the
American Water Works Association
521 Fifth Avenue
New York 17, New York
or any steel pipe manufacturer.



A gondola car loaded with 800 feet of 20" coal tar enamel lined, coated, wrapped and whitewashed steel pipe ready for unloading

BIBLIOGRAPHY

"Steel Trunk Lines with Bell and Spigot Joints," by W. W. Hurlbut. Journal of The American Water Works Association, (September 1930).

"Electrically Welded Steel Water Pipe," by W. H. Powell. The Canadian Engineer, (November 4, 1930).

"San Lorenzo Pipe Line for San Francisco," by —. —. Newark. Western Construction News, (October 25, 1931).

"Construction of New Otay-San Diego Water Line." American City, (February 1931).

"Sultan River Water Supply for Everett," by J. W. Cunningham. Western Construction News, (May 10, 1932).

"Hetch Hetchy San Joaquin Valley Pipe Line," by A. G. Darwin. Western Construction News, (January 25, 1932).

"Welding a Large Water Pipe Line at Vancouver, B.C.," by W. H. Powell. The Canadian Engineer, (October 31, 1933).

"Constructing the Bouquet Canyon Pipe Line," by H. A. Van Norman. Civil Engineering, (June 1934).

"Washington Completes Large Pipe Line." Waterworks Engineering, (May 30, 1934).

"Welding 78" Steel Supply Line for Seattle Water Department," by G. W. Desellem. Engineering News Record (August 16, 1934).

"All Welded Steel Pipe Brings Water to Pasadena," by S. B. Morris. Western Construction News, (October 1934).

"The Bouquet Canyon Dam and Inlet-Outlet Pipe," by W. W. Hurlbut. Journal of The American Water Works Association, (Vol. 27, No. 8, 1935).

"Steel Pipe 11½ ft. in Diameter Welded by Improved Methods." Engineering News-Record, (May 20, 1937).

"Large Delivery Lines for the Colorado Aqueduct System," by Julian Hinds. Civil Engineering, (July 1938).

"Electric Welding Used in Construction of Pump Discharge Pipe Lines in Montana," by Stuart Rose. Pacific Purchaser, (September 1939).

"Colorado Aqueduct Distribution System," by Julian Hinds. Journal of The American Water Works Association, (Vol.31, November 1, 1939).

"New High Pressure Steel Water Supply Line for Colorado Springs," by E. L. Mosley. Journal of The American Water Works Association, (August 1940).

"Steel Pipe Feeder Line for Orange County Cities Completed." Southwest Builder and Contractor, (May 1941).

"Design Standards for Steel Water Pipe," by Russell E. Barnard. Journal of The American Water Works Association, (January 1948).

"Design Standards for Large-Diameter Steel Water Pipe," by Walter H. Cates. Journal of The American Water Works Association, (September 1950).

"Field Welding of Steel Water Pipe," by H. Arthur Price and G. H. Garrett. Journal of The American Water Works Association, (October 1943).

"Laying a 36-inch Main Through Traffic," by S. J. Benedict. Journal of The American Water Works Association, (November 1947).

"Welded Steel Pipe Line of the Panther Valley Water Company," by Farley Gannett. Journal of American Welding Society, (February 1933).

"Siphon Self-Supporting in Long Spans," by P. J. Bier. Engineering News-Record, (June 20, 1940).

"Increased Span Length on Large Pipe Obtained by Ring Girder Suspension," by Burton S. Grant. Engineering News-Record, (May 3, 1945).

"Design of Long-Span Self-Supporting Steel Pipe," by Gairald H. Garrett. Journal of The American Water Works Association, (November 1948).

"Notable Steel Pipe Installations," by Julian Hinds. Journal of The American Water Works Association, (July 1954).

"Shop and Field Inspection of Steel Water Mains," by Edward J. Clark. Journal of The American Water Works Association, (August 1949).

"Outline of Design Factors for Steel Water Pipe Lines," by Russell E. Barnard. A.W.W.A. Journal, Vol. 36, No. 1, (January 1944).

"Report of Committee on Pipe Line Friction Coefficients. Journal of the New England Water Works Association, (Vol. XLIX, No. 3).

"Collected Standard Specifications for Service Line Materials." (American Water Works Association publication 1-1948).

"Design of Steel Ring Flanges for Water Works Service," by Russell E. Barnard. Journal of The American Water Works Association, (October 1950).

"Service Life of Coal-Tar Enamel Protective Coatings," by Harry Hayes. Journal of The American Water Works Association, (October 1940).

"Flow Tests on Thirty Inch Steel Pipe Lined With Coal Tar Enamel in 1932." Reprinted from Journal of the New England Water Works Association, Vol. LVI, No. 1.

"75-inch Pipeline Climbs Mountain in 8 Weeks." Engineering News-Record, (February 17, 1949).

"More Water for St. Louis," by John B. Dean. Water Works Engineering, (April 13, 1938).

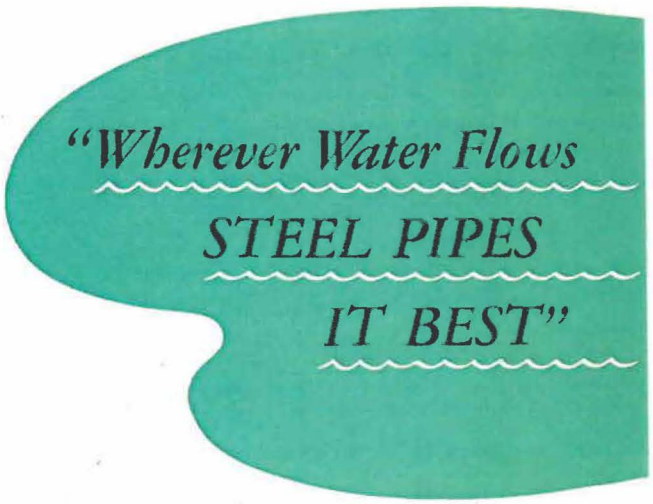
"25-mile Conduit Adds 100 mgd. for Portland," by Guy Browning Arthur. Public Works, (August, 1953).

"Mechanical Joints for Water Lines," by Elson T. Killam. Journal of The American Water Works Association, Vol. 35, No. 11, (November 1943).

"Parker-Schram Licks Bad Weather." Pacific Builder and Engineer, (February 1951).

"Sewage-Water Pipeline to Steel Plant." Engineering News-Record, (September 22, 1955).

Design of Wye Branches for Steel Pipe by H. S. Swanson, H. J. Chapton, W. J. Wilkinson, C. L. King, and E. D. Nelson. Reprinted by the American Water Works Association.



STEEL PIPE MEETS THESE 7 ESSENTIAL REQUIREMENTS FOR A WATER PIPE LINE

1. Outstanding strength
2. Extreme durability and long life
3. Economy of installation and maintenance
4. High carrying capacity
5. Ductility and adaptability
6. Great reliability and resiliency
7. "Bottle-tight" joints.

"Wherever Water Flows STEEL PIPES IT BEST"

PUBLISHED BY THE STEEL PLATE FABRICATORS ASSN., 79 W. MONROE ST., CHICAGO 3, ILL., 1955

STEEL PLATE FABRICATORS ASSOCIATION
FOUNDED 1933

Compliments of

KOPPERS COMPANY, INC.

Tar Products Division

Pittsburgh 19, Pa.

DISTRICT OFFICES:

BOSTON OFFICE: 250 Stuart St., Boston 16, Mass., Tel. HAncock 6-1700

BIRMINGHAM OFFICE: Woodward, Ala., Tel. Birmingham 58-1611

CHICAGO OFFICE: 122 S. Michigan Ave., Chicago 3, Ill., Tel. WEbster 9-2400

LOS ANGELES OFFICE: 3450 Wilshire Blvd., Los Angeles 5, Calif., Tel. DUnkirk 8-0676

NEW YORK OFFICE: 430 Park Ave., New York 22, N. Y., Tel. PLaza 5-2810

PITTSBURGH OFFICE: Koppers Building, Pittsburgh 19, Pa., Tel. EXpress 1-3300

PRINTED IN U.S.A.

EXHIBIT S-24-1.8